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Book Reviews

Implications of the Durham Case Decision*

*Manfred S. Guttmacher, M.D.,** Baltimore, Md.*

It is not my purpose to trace the developmental history of the laws dealing with legal responsibility, since our assigned task is to consider the Durham decision. However, it seems to me worth while to sketch the historical background in bold strokes, so that we can achieve a perspective.

By Edward I's reign, in the 13th century, insanity was recognized as an excuse to crime, automatically meriting a royal pardon. By the reign of Edward III, the chattels of the offender were no longer forfeited to the Crown in the case of a malefactor who was declared to be a madman.

This attitude toward the insane criminal is world-wide. Westermarck (1) states in his Origin and Development of the Moral Ideas, "even savages recognize that lunatics and maniacs are not responsible for their deeds."

I should like to point out that it was early recognized in English law that there were degrees of mental disorder, that a differentiation was made between congenital intellectual deficiency and mental disorder acquired later, and that only the extreme degrees of mental disorder lead to exculpation.

Lord Matthew Hale (2), writing in the middle of the seventeenth century, said "doubtless, most persons that are felons and others are under a degree of partial insanity, when they commit these offenses. It is very difficult to define the invisible line that divides perfect and partial insanity; but it must rest upon circumstances duly to be weighed and consid-

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** Chief Medical Officer, Supreme Bench of Baltimore, Court House, Baltimore, Maryland.

ered by both judge and jury, lest on the one side there be a kind of inhumanity toward the defects of human nature, or, on the other side too great indulgence given to great crimes." So that you see for a period of 300 years the law has been involved in the problem of separating out that small group of individuals who should justly be considered irresponsible, because of their mental condition, from the great body of offenders. A hundred years ago, a judge, Baron Bramwell, said in sentencing a prisoner in England, "That you are of unsound mind, I believe, but that is no reason why you should not be punished . . . I feel bound to sentence you to the same punishment as if you were sane."

At the end of the first quarter of the eighteenth century, Justice Tracy (3) charged that for a man to be irresponsible he must be incapable of forming a criminal intent and in order to qualify for this "he must be totally deprived of his understanding and memory, and doth not know what he is doing, no more than an infant, than a brute, or a wild beast."

By the middle of the eighteenth century the Solicitor General for the Crown, in the case of Earl Ferrers (17), said that the chief criterion of responsibility was whether at the time of the alleged criminal act the defendant could distinguish between good and evil.

In 1800, Lord Erskine (18), one of the greatest criminal lawyers of all times, was given the task of defending an English army veteran, Hadfield, who attempted to assassinate George III in Drury Lane Theater. He attacked the theory that the proper test was the ability of the individual to distinguish between good and evil, which had assumed increasing importance during the eighteenth century. He declared that "the deprivation of reason" should acquit a man of crime and that its chief manifestation was the presence of delusions.

Just before the middle of the nineteenth century, in 1843, there occurred in London, the famous McNaghten case, which until now has served as the chief source of the law on criminal responsibility in 47 of our 48 states.

In 1843, Daniel McNaghten, a Scot, had the insane delusion that Sir Robert Peel, the Home Secretary, was depriving him of his rights. He was unable to secure legal redress and deciding to take the law into his own hands he mistakenly shot

and killed Sir Henry Drummond, the secretary to Sir Robert. This immediately became a *cause célèbre.* Lord Chief Justice Tindal, who presided over the three judge court, practically directed the jury to find the defendant insane. Even Queen Victoria became involved, writing to Peel about the matter. Parliament considered the case at length and decided "to take the opinion of the Judges on the law governing such cases."

The chief rule, that grew out of the answers of the fifteen Learned Law Judges to the five questions propounded by Parliament, states that a defendant is criminally insane if he, "was laboring under such a defect of reason, from disease of the mind, as not to know the nature and quality of the act he was doing, or if he did know it that he did not know he was doing what was wrong."

The second most important answer takes up Erskine's doctrine of delusions. It states, "we think he (the defendant) must be considered in the same situation as to responsibility as if the facts with respect to which the delusions exist were real."

The Rules were almost immediately criticized by leaders in psychiatry. Dr. Isaac Ray (4), the leading American authority on forensic psychiatry, said, in regard to the rule on delusions, "this is certainly very plain, and it must be the fault of the lunatic if he does not understand it. It is very reasonable, too, if insane men would but listen to reason."

In regard to the knowledge of right and wrong rule, he wrote (4), "Jurists who have been so anxious to obtain some definition of insanity, which shall furnish a rule for the determination of responsibility, should understand, that such a wish is chimerical from the very nature of things." This is much like a statement made recently by one of the present day leaders of American psychiatry, Professor John Whitehorn (5) of Johns Hopkins, "Psychiatrists are challenged to set forth a crystal clear statement of what constitutes insanity. It is impossible to express this adequately in words, alone, since such diagnostic judgments involve clinical skill and experience which cannot wholly be verbalized. . . . The medical profession would be baffled if asked to write into the legal code universally valid criteria for the diagnosis of the many types of psychotic illness which may seriously disturb a per-

son's responsibility, and even if this were attempted the diagnostic criteria would have to be rewritten from time to time with the progress of psychiatric knowledge."

Dr. Henry Maudsley (19), the leader of forensic psychiatry in England during the last half of the nineteenth century, in the preface to his Responsibility in Mental Disease, spoke of "The scorn and indignation felt by those who observe with impatience, the obstinate prejudice with which English judges hold to the absurd dictum, which has long been discredited by medical science."

Contemporaneous with, and quite independent of, McNaghten, the doctrine of the irresistible impulse was being developed in the United States. One of the early and one of the chief criticisms of McNaghten Rules was that they dealt only with the cognitive element in mentation. Sir James Stephens (20), in his famous History of the Criminal Law, pointed out that the Rules disregarded emotion and will. This was the era of faculty psychology, when the mind was divided into discrete compartments. In one of the most important of the early irresistible impulse cases, Chief Justice Lemuel Shaw of Massachusetts said, "In order to constitute a crime, a person must have intelligence and capacity enough to have a criminal intent and purpose; and if his mental powers are either so deficient that he has no will, no conscience or controlling mental power, or if, through the overwhelming violence of mental disease, his intellectual power is for the time obliterated, he is not a responsible moral agent, and is not punishable from criminal acts." Fifteen states and the courts of federal jurisdiction have as their law of criminal responsibility, the irresistible impulse rule plus the right and wrong rule, while thirty-two states have the right and wrong rule alone. Dr. Frederic Wertham, a prominent psychiatrist maintains that there is no such entity as an irresistible impulse.

Professor Jerome Hall (6) of the University of Indiana Law School holds that an irresistible impulse does not and cannot exist concomitantly with unimpaired knowledge of right and wrong.

A poll of leading American psychiatrists has disclosed that the great majority believe that there are impulses which patients cannot resist. In fact, Dr. Henry Davidson (7) has

suggested that the chief criterion of responsibility should be whether an accused would have carried out the prohibited act even if a policeman had at the time been at his elbow. I cannot agree with Professor Hall. There are, I feel, certain mentally disordered individuals who are capable of meeting the knowledge of right and wrong test, but are incapable of adhering to the right, because of defects of will—nor can I agree with Dr. Davidson. I have seen seriously psychotic individuals postpone their insane acts until they were left alone with their victim.

In the 1860's the little state of New Hampshire blazed a trail. This was due to the efforts of a triumvirate of distinguished jurists, Judges Doe, Ladd and Perley. They, in turn, had been educated and influenced by a remarkable young physician, Isaac Ray, who was born in Beverly, Massachusetts, and graduated in 1807 from Harvard Medical School, at 20. He published his "Medical Jurisprudence of Insanity" in 1838 and in 1847 became Superintendent of Butler Hospital in Providence, Rhode Island.

Judge Charles Doe wrote to Dr. Tyler, Professor of Mental Disease at Harvard, in 1866 in regard to a dissent that he was preparing in a case involving insanity. He had read Ray's treatise and said in his letter to Dr. Tyler that were he acquainted with him he would like to present the matter to him. Dr. Tyler apparently acted as intermediary, and as a result there was produced the Doe-Ray correspondence, which was published by Dr. Reik (8). In the near century that has passed, there has been no comparable cooperative effort by members of the legal and medical professions.

Dr. Ray (4) advocated two important principles: (1) The external manifestations of mental disease are so inconstant and uncertain that no legal definition or test of universal application is possible; (2) There is a form of mental illness in which behavior is so disordered that in spite of seemingly intact intellectual ability and the absence of delusion, the patient seems to be the victim of forces beyond his control.

Judge Doe stated his point of view very clearly in a letter to Dr. Ray in 1868,

> ". . . I think the common law is as follows: It does not recognize 'only a certain kind or degree of insanity as

having any legal consequences'; it recognizes insanity as disease, and so far as contracts and crimes are governed by the common law, they cannot be produced by disease of the mind. Whether, in any particular case there is mental disease, and, if there is, whether a certain transaction is a product of the disease,—are questions of fact for the jury and not of law for the court. The court can only instruct the jury that a product or an offspring of mental disease is not a contract or a crime.

"The law does not declare every act of an insane person a nullity, because the law does not know that every act of an insane person is necessarily caused by his insanity. As I have said, the law is exhausted when it declares every product of mental disease a nullity. When judges learn that such is, and always was, the law, and confine themselves to it, the spirit and principle of law will be splendidly vindicated. Errors and mistakes of the great masters of our law, such as Coke, Hale, Blackstone, Mansfield, Marshall, Story, Taney, etc. on other subjects and branches of the law have been discovered and acknowledged, and courts have recognized the true principle of the law, however long it may have been misunderstood. And there is no peculiar reason for according the infallibility of any number of lawyers and judges in regard to the law of insanity. . . ."

Out of this was born the New Hampshire Rule, that an accused is not criminally responsible if his unlawful act was the product of mental disease or mental defect.

Now let us return to the McNaghten Rules, with their pronouncement that an accused must be found responsible if at the time of the act he knew the nature and quality of the act he was doing and knew that it was wrong.

The McNaghten Rules have been assailed by leaders of American Psychiatry from Isaac Ray to Winfred Overholser. Recent polls of psychiatric opinion of the members of the American Psychiatric Association and the Group for the Advancement of Psychiatry have assailed them. In the former poll 12% felt they could work successfully with the Rules, 79% could not do so. A poll of Canadian psychiatrists showed that 84 of 86 rejected the McNaghten Rules plus the irresistible impulse. The chief objections to the McNaghten Rules

are: (1) These criteria have no reality in the field of mental disease. They stress entirely the cognitive and disregard the emotional and volitional aspects of mentation. They give no recognition whatever to the unconscious. As Mr. Justice Cardoza stated it in his address before the New York Academy of Medicine (21), "Everyone concedes that the present (legal) definition of insanity has little relation to the truths of mental life." (2) The Rules are framed in ethical terms. A psychiatrist has no particular competence in dealing with these concepts nor with their terminology. They are completely alien to him in his day-to-day work with patients. It never occurs to him in his practice to consider these concepts. He has to translate into the McNaghten framework his knowledge of the patient's mental condition, gathered from his examination dealing with the presence or absence of delusions and hallucinations, degree of orientation present, condition of the patient's mood, contact with reality, presence or absence of bizarre ideation and concretistic thinking, memory, judgment, ability to calculate, etc. (3) Mental disease is born out of the basic personality structure of the patient. Since no two persons are truly alike, and since there is such a great variety of personality characteristics, the manifestations of mental disorder are protean and defy all attempts to put them into a neatly circumscribed definition of universal applicability.

The McNaghten Rules have been stoutly defended and have been treated as sacrosanct by the legal profession in the past. During the first half of this century criticism came almost exclusively from psychiatrists and two outstanding law professors, Sheldon Glueck of Harvard and Henry Weihofen, of the University of New Mexico.

The avowed purpose of the tests of criminal responsibility is to select mentally disordered defendants whose punishment would be considered inhumane—individuals who cannot be deterred by threats of penal sanctions and whose punishment cannot act to deter other members of the community from engaging in similar anti-social behavior. The defenders of the McNaghten Rules and the irresistible impulse, have claimed that these aims have been effectively accomplished for more than one hundred years, by these legal tests. Of this most psychiatrists are extremely sceptical.

Those who have most staunchly preferred the McNaghten test to the formulation of criminal responsibility presented by the New Hampshire test, speak of the former test's definiteness and the latter test's vagueness. They say the right and wrong formulation gives the judge and the jury something to hang on to, to sink their teeth into, they claim that in it we have a calibrated scale of measurement. It is the view of many, and this I share, that this definiteness is wholly illusory. One needs only turn the pages of the recently published book by Professor Weihofen (22), "Mental Disorder as a Criminal Defense," to learn how, in the course of a century, every phrase in the McNaghten formula has been given varying and frequently contradictory interpretations by the courts. In the opinion in the famous case of Father Schmidt, Mr. Justice Cardozo interpreted knowledge of right and wrong to refer to moral right and wrong. In 1952 so authoritative a legal body as the English Court of Criminal Appeal decided that "wrong" referred to legal wrong and not to moral wrong.

Complaints are sometimes made that the psychiatric expert often seems vague and equivocal in his reply to questions on the witness stand which are couched in McNaghten terms. To this I shall personally plead guilty, because frequently it is nearly impossible to reach a definitive conclusion about a defendant's ability to distinguish right from wrong and to appreciate the nature and consequence of an act carried out many months before trial. So that while the jury may gain a certain, and I feel often specious, sense of definiteness from the McNaghten formulation, they are likely to secure a good deal of indefiniteness from the answers of the really conscientious psychiatric expert.

Many persons in our country point to the fact that English law has resisted any change in the McNaghten Rules, even failing to accept the doctrine of irresistible impulse. Dr. Eliot Slater (9), a leading British authority, has recently given us an excellent insight into this. He writes,

> "In the majority of cases which come before the courts the McNaghten Rules are a dead letter; in a minority of cases they are applied in full vigor. Notorious cases, in which much public feeling was aroused, and in which they were strictly applied, are the cases of Heath, Haigh and

> Straffen. The person who decides whether the Rules shall be applied strictly, loosely or not at all is the trial judge. The late Sir Norwood East, the conservative leader of English forensic psychiatry and a warm supporter of the Rules testified before the Royal Commission on Capital Punishment, 'If the Judge is perfectly satisfied that the man is insane, he is quite likely to stretch the McNaghten Rules, and does stretch them so far that they may not be used at all.' "

Dr. Slater gives us some very interesting statistics on murder in England and Wales. There are only about 150 murders a year. Over the course of 50 years in 22% of murders known to the police the suspects committed suicide. Of murderers brought to trial at Assizes, 14% were found unfit to plead on psychiatric grounds. Of those charged 39% were found guilty, but insane. Of those sentenced to death, 4% were respited to Broadmoor, an institution for the criminal insane, and a further 42% had their sentences commuted to penal servitude, in a fair proportion of cases on psychiatric grounds.

Certainly, from this, one must conclude that the McNaghten Rules do not function ideally in England. They would seem to lend themselves all too readily to loose judicial practices and to serious inequities.

Since 1950 several events of the first importance have occurred, that serve as indisputable evidence that many leaders of the American Judiciary and the American Bar have become dissatisfied with the century old criteria of criminal responsibility found in the McNaghten Rules and the irresistible impulse.

Chief Judge John Biggs of the United States Court of Appeals for the third circuit filed a vigorous dissent in the case of Smith v. Baldi, on October 26, 1951. In referring to the McNaghten Rules he writes (10):

> "The human mind, however, is an entity. It cannot be broken into parts, one part sane, the other part insane. The law, when it requires the psychiatrist to state whether in his opinion the accused is capable of knowing right from wrong, compels the psychiatrist to test guilt or innocence by a concept which has almost no recog-

> nizable reality. We use the word 'almost' advisedly for it is conceivable that the drooling, quaking, imbecile has no quality of mind whatsoever and therefore would not or could not know the difference between right and wrong. Such an individual would be unlikely to commit a crime since the commission of crime and some activity of mind and body seem inseparable."

The opinion continues,

> "It need not be always so. Changes can be effected and reason can be brought to the law of criminal insanity. The rule of McNaghten's Case was created by decision. Perhaps it is not too much to think that it may be altered by the same means. If not, then legislation must prevail. Perhaps the McNaghten Rule may be modified by a Pennsylvania Court in this, Smith's, case."

The Royal Commission on Capital Punishment published its report in September 1953. In it there occurs the testimony which Mr. Justice Frankfurter gave before the Commission. He (23) declared forthrightly:

> "The McNaghten Rules were rules which the Judges, in response to questions by the House of Lords, formulated in the light of the then existing pyschological knowledge. I do not see why the rules of law should be arrested at the state of psychological knowledge of the time when they were formulated. If you find rules that are, broadly speaking, discredited by those who have to administer them, which is, I think, the real situation, certainly with us—they are honoured in the breach and not in the observance—then I think the law serves its best interests by trying to be more honest about it . . . I think that to have rules which cannot rationally be justified except by a process of interpretation which distorts and often practically nullifies them, and to say the corrective process comes by having the Governor of a State charged with the responsibility of deciding when the consequences of the rule should not be enforced, is not a desirable system . . . I am a great believer in being as candid as possible about my institutions. They are in large measure abandoned in practice, and therefore I think the McNaghten Rules are in large measure shams. That is a strong word, but I think the McNaghten Rules

> are very difficult for conscientious people and not difficult enough for people who say 'We'll just juggle them' . . . I dare to believe that we ought not to rest content with the difficulty of finding an improvement in the McNaghten Rules . . ."

The Royal Commission on Capital Punishment recommended in its final report, a change in the law, which would (24) "leave the jury to determine whether at the time of the act the accused was suffering from disease of the mind (or mental deficiency) to such a degree that he ought not to be held responsible."

In 1955, Judge Simon Sobeloff (11), while Solicitor General of the United States, warned that "what we ought to fear above all is not the absence of a definition, but being saddled with a false definition. We must avoid the rigidity which precludes inquiry, which shuts out light and insists on concepts that are at odds with things known and acknowledged not only by the medical profession but by all informed men."

Now let us move on from considerations of the deficiencies in the McNaghten Rules to a more positive approach—a consideration of the opinion in the Durham case and its important implications.

Monte Durham was convicted of breaking into the Georgetown house of Donald Hiss, the brother of Alger Hiss, while the family was away. He was then 23 years of age. He had had a long history of imprisonments and hospitalizations. He had attempted suicide and was hospitalized at St. Elizabeths for two months before he was 20. A year later, while he was serving a jail sentence for motor theft, his behavior was so abnormal that he was brought before the Municipal Court for a lunacy inquiry where a jury found him to be of unsound mind. This time he was in St. Elizabeths for 15 months under the diagnosis of "psychosis with psychopathic personality." He was discharged in 1949 and promptly passed some bad checks. A jury again found him to be of unsound mind. This time he was in St. Elizabeths for 3 months, but was diagnosed as "without mental disorder, psychopathic personality." Two months later he was involved in the housebreaking case. According to his mother, and the psychiatrist who examined him, he had again developed hallucinations a

month after his third discharge from St. Elizabeths and a month before the housebreaking. After his arrest he was committed to St. Elizabeths for the fourth time and was given subshock insulin. After 16 months he was returned to court to stand trial, and was convicted of a felony. His conviction was appealed by his very able attorney, Mr. Abe Fortas, who had been appointed by the court to represent him.

Judge David Bazelon, sitting with Judges Edgerton and Washington, of the United States Court of Appeals of the District of Columbia, rendered the opinion on the appeal on July 1, 1954. (21)

The opinion contains a scholarly review of some of the more important psychiatric writings dealing with the tests of criminal responsibility. Let me read to you some excerpts from this important opinion. It states (12):

> "By its misleading emphasis on the cognitive, the right-wrong test requires court and jury to rely upon what is, scientifically speaking, inadequate, and most often, invalid and irrelevant testimony in determining criminal responsibility."

In another place the opinion says:

> "The fundamental objection to the right-wrong test, however, is not that criminal irresponsibility is made to rest upon an inadequate, invalid or indeterminable symptom or manifestation, but that it is made to rest upon *any* particular symptom. In attempting to define insanity in terms of a symptom, the courts have assumed an impossible role, not merely one for which they have no special competence. As the Royal Commission emphasizes, it is dangerous 'to abstract particular mental faculties, and to lay it down that unless these particular faculties are destroyed or gravely impaired, an accused person, whatever the nature of his mental disease, must be held to be criminally responsible . . . .' In this field of law as in others, the fact finder should be free to consider all information advanced by relevant scientific disciplines."

The opinion concludes:

> ". . . Under the rule now announced, any instruction should in some way convey to the jury the sense and sub-

stance of the following: If you the jury believe beyond a reasonable doubt that the accused was not suffering from a diseased or defective mental condition at the time he committed the criminal act charged, you may find him guilty. If you believe he was suffering from a diseased or defective mental condition when he committed the act, but believe beyond a reasonable doubt that the act was not the product of such mental abnormality, you may find him guilty. Unless you believe beyond a reasonable doubt either that he was not suffering from a diseased or defective mental condition, or that the act was not the product of such abnormality, you must find the accused not guilty by reason of insanity. Thus your task would not be completed upon finding, if you did find, that the accused suffered from a mental disease or defect. He would still be responsible for his unlawful act if there was no causal connection between such mental abnormality and the act. These questions must be determined by you from the facts which you find to be fairly deducible from the testimony and the evidence in this case.

"The questions of fact under the test we now lay down are as capable of determination by the jury as, for example, the questions juries must determine upon a claim of total disability under a policy of insurance where the state of medical knowledge concerning the disease involved, and its effects, is obscure or in conflict. In such cases, the jury is not required to depend on arbitrarily selected 'symptoms, phases or manifestations' of the disease as criteria for determining the ultimate questions of fact upon which the claim depends. Similarly, upon a claim of criminal irresponsibility, the jury will not be required to rely on such symptoms as criteria for determining the ultimate question of fact upon which such claim depends. Testimony as to such 'symptoms, phases or manifestations,' along with other relevant evidence, will go to the jury upon the ultimate questions of fact which it alone can finally determine. Whatever the state of psychiatry, the psychiatrist will be permitted to carry out his principal court function which as we noted in [Holloway v. U. S.] 'is to inform the jury of the character of [the accused's] mental disease [or defect].' The jury's range of inquiry will not be limited to, but may include, for example, whether an accused, who suffered from a

> mental disease or defect did not know the difference between right and wrong, acted under the compulsion of an irresistible impulse, or had 'been deprived of or lost the power of his will . . . .'"

The Durham decision, with its rejection of the McNaghten Rules and the irresistible impulse, and its acceptance of the old New Hampshire test of responsibility, has met with almost universal acclaim from psychiatrists. The chief merit of the opinion, in the minds of psychiatrists was well put by Mr. Justice Douglas in an address that he delivered in New York in January 1956 (13),

> "The great significance of the Durham case is that the broad test adapted enables the psychiatrist to testify in his own language and to give evidence that is relevant by the standards known to him . . . . He is at last free to advise the court and the jury concerning the totality of the accused's personality and condition. No longer is he forced to divide a person up into a rational being and an emotional one, to divorce his conscious from his unconscious state, or to separate the knowing part of the mind from the willing part or the feeling part . . . . The only warrant for the McNaghten rule of insanity was tradition. The new approach finds the postulates of the law in medical and psychiatric experience and judgment."

The Durham opinion has not met with the unanimous approval of the legal profession. Thus far the Rule has been accepted in only one court of review and in a rather extraordinary case. Recently the Supreme Court of Minnesota (14) had before it the case of a man who shot and killed his wife. The wife's heirs attempted to prevent the transfer of the dead woman's property to the husband, on the theory that a malefactor cannot legally profit from his criminal act, even though this man had been committed to a institution as insane without trial. The lower court denied the killer the right to benefit from his act because a psychiatrist testified that the defendant "knew the difference between right and wrong and had full realization of its legal consequences." This decision was reversed by the Supreme Court of Minnesota. The opinion, in part reads:

"The fact that [he] committed the act knowing it was wrong with full realization of its consequences should not be considered in a vacuum apart from the disease which produced the act. We feel that the better rule to be applied to the case before us is that the slayer will not be barred from taking the property where his unlawful act was the product of mental disease. In light of the present-day medical knowledge of the nature of mental diseases, it is not realistic to apply the arbitrary right-and-wrong test to the facts in this case.

"The record is replete with evidence supporting both doctors' testimony that the defendant was afflicted with a serious mental disease at the time when he killed his wife, and we find that there was a sufficient causal relation between the disease and the killing to warrant a finding that it was the defendant's insanity and not his own conscious act which caused the death of his wife. Therefore, the equitable principle that one should not be permitted to profit by his own wrong does not apply to the facts in this case and a constructive trust will not be imposed."

You are probably aware of the fact that the American Law Institute has been engaged, during the past five years, in drafting a model penal code. The funds for this gigantic undertaking have been given it by the Rockefeller Foundation. The staff of recorders who are responsible for the drafting is lead by Professor Herbert Wechsler of Columbia Law School, a brilliant lawyer and teacher. They are assisted by an Advisory Committee of more than thirty judges, lawyers, law professors, criminologists and psychiatrists. I am one of the three psychiatrists on this Advisory Committee. Professor Wechsler began his comments on the part of the Code dealing with criminal responsibility with these words (15), "No problem in the drafting of a penal code presents larger intrinsic difficulty than that of determining when individuals whose conduct would otherwise be criminal ought to be exculpated on the ground that they are suffering from mental disease or defect when they acted as they did."

Professor Wechsler and his staff have been adamant in their refusal to accept the Durham Rule as the test of responsibility. They state their chief objection thus:

> "The difficulty with this formulation inheres in the ambiguity of 'product.' If interpreted to lead to irresponsibility unless the defendant would have engaged in the criminal conduct even if he had not suffered from the disease or defect, it is too broad: an answer that he would have done so can be given very rarely; this is intrinsic to the concept of the singleness of personality and unity of mental processes that psychiatry regards as fundamental. If interpreted to call for a standard of causality less relaxed than but-for cause, there are but two alternatives to be considered: (1) a mode of causality involving total incapacity or (2) a mode of causality which involves substantial incapacity."

I am unable to grasp the full import of this objection to the Durham formulation. No doubt the difficulty is in part a semantic one, a curse that plagues communication between different disciplines. "Product" has apparently a different connotation to lawyers and doctors. This is also suggested in Professor Henry Weihofen's defense of the Durham Rule. He (16) writes,

> "The term product implies a 'causal connection,' as the court in the Durham case indicated. And causation, as every lawyer knows, is a formidable source of difficulty.
>
> "At the most elementary level, we have the basic question, does the rule mean that the disorder must have been *the* cause of the act, or merely one cause? To a philosopher, cause has a fairly simple meaning. One fact or event is the cause of another when the existence of the first is necessary to the existence of the second. In this sense, there may be and usually are a great many causes for every fact or event.
>
> "But in law, we have learned after long wrestling with the problem that although we use the same word, causation as the lawyer uses it is a wholly different concept from the philosopher's or the scientist's. In law, we usually concern ourselves only with the more or less direct causes of events, with what we call proximate cause. And we have learned that that concept can be used intelligently only by recognizing that what is proximate depends upon the point of view or purpose behind the inquiry. If the question is, what caused a certain individual to commit a given act, a medical man would be

> inclined to single out the factor that he would deal with, by application of his special knowledge and skills, if he were seeking to cure or prevent a repetition of the occurrence. But, a sociologist might attribute as cause the social phenomenon that *he* would work on if *he* were called upon. One man's cause may be another man's incidental."

We physicians are dealing every day with symptoms that we consider to be the products of a certain disease entity. This does not ordinarily baffle us.

The tentative formulation of the test of responsibility by the drafters of the Model Code reads (15), "A person is not responsible for criminal conduct if, at the time of such conduct as a result of mental disease or defect he lacks substantial capacity either to appreciate the criminality of his conduct or to conform his conduct to the requirements of law."

This is certainly preferable to the old Rules of McNaghten and of the Irresistible Impulse. It is, in fact, a skillful translation of these time-honored rules into current vernacular. Moreover, procedural changes advocated in the Model Code of the Institute, make their test more acceptable. They include the appointment of one or more psychiatrists to act as neutral examiners to advise the Court whenever an insanity plea is made, and provisions permitting the psychiatric experts, in presenting their testimony, to make a full statement as to the defendant's mental condition, with any explanation deemed necessary to clarify the diagnosis and the opinion.

The Code also provides that evidence of mental disease or defect shall be admissible in regard to the state of mind, which is an element of the offense. This will, of course, be chiefly in homicide cases, as to the accused's ability to deliberate and premeditate, at the time of his criminal act. Another provision of the Tentative Draft of the Model Code is that in an insanity plea the burden shifts so that the prosecution must disprove irresponsibility beyond a reasonable doubt.

In my opinion, the greatest defect in the responsibility formulation of the American Law Institute is that it still too greatly circumscribes the psychological components to be considered. The mind is totally integrated and should not be viewed from any specially selected facets. It seems to me too,

that the inclusion of the word "substantial," although it has certain values, is surely open to the charge of ambiguity. If the rule is generally adopted it will doubtless be the subject of numerous legal disputations.

I look for much of the difficulty with the Durham Rule to come from the term "mental disease." It is true that all of the formulae, past and present, for determining criminal responsibility, make use of this term and theoretically the problem has presented itself and should continue to present itself with each of them. But, it is the heart of the Durham Rule and in it, it stands out quite nakedly.

Much of psychiatry is without any structural pathology, and the line between dysfunction and disease is a very shadowy one. Even in the realm of physical disorders there are may instances in which it is far from clear where the critical demarcation of disease should be applied; e. g., at what point and under what conditions should hypertension be thought of as a disease. In what instances of hyperglycemia or glycosuria should the disease diabetes, be diagnosed. How much spasticity of the colon is needed to denominate it a disease. One could go on to multiply such instances.

The psychoses are clearly diseases. But how severe and incapacitating must a compulsion neurosis be to be considered a mental disease. And what about the psychopathies? Both the report of the Royal Commission on Capital Punishment and the tentative draft of the Model Criminal Code of the American Law Institute state categorically that the psychopathic disorders shall not be considered to be mental disease. And, I have been informed that the staff of St. Elizabeths hospital in Washington, in testifying under the Durham Rule, excludes all psychopaths from the group of the mentally diseased. Yet, Dr. Hervey Cleckley (25), in his excellent volume on these behavior or character disorders, "The Mask of Sanity," is of the opinion that many severe psychopaths are less able to conform to society's restrictions than many psychotics.

Our views in regard to the psychopaths are undergoing a marked change. Under the influence of German psychiatry of an earlier period psychopathy was believed to be a constitutional defect, an inherited character deformity. It is now

generally thought to be the result of early brain trauma or of serious affectional deficiencies and conflicting disciplinary forces in the early environment. I question the wisdom of the general and categorical exclusion of character disorders from consideration as to responsibility. There are now 22 states and the District of Columbia that have sexual psychopath statutes. In many of these, provisions are made for indeterminate commitment to the State Hospital of the sexual psychopaths as though they were insane. In Maryland we have a new institution midway between a mental hospital and a penal institution known as the Patuxent Institution, which is directed and professionally staffed by psychiatrists, to which severe and dangerous cases of character disorder can be indeterminately committed for treatment. Commitment of these cases, even though it occurs only after sentence for crime, has been declared by the Maryland Court of Appeals, to be a civil procedure.

Recently I had the opportunity of visiting a remarkable institution for criminals of this type in Herstedvester, Denmark. Dr. George Sturup, an excellent psychiatrist, who has been its director for more than ten years, is optimistic about what the institution is accomplishing. It makes use of a special treatment technique, depending largely on group therapy and the ever present social pressures from living in the group, of which the inmate is an integrated member.

I can see no great injustice nor any serious social harm if the court or jury decides to commit some of the more aggravated cases of character disorder to mental hospitals as irresponsible. Perhaps the necessity of studying and treating these cases will produce a clearer knowledge of their psychogenesis and more effective methods for their treatment.

Dr. Winfred Overholser, the leader of forensic psychiatry in America, and the superintendent of the great hospital for the insane in the District of Columbia, has informed me that, during the nearly three years that the Durham Rule has been in force there, courts and juries have not found more criminal defendants insane than formerly. He is a vigorous proponent of the Durham Rule. The chief prosecuting attorney, who was not orginally enthusiastic about the Rule, has stated that it has worked well.

Supreme Court Justice William Douglas (13) states, "The new regime of the Durham case does not offer perfection, but there is certain to be betterment."

Summary

Ever since the McNaghten Rules were enunciated in 1843, there has been dissatisfaction with them expressed by the leaders of psychiatry in the United States and England.

During the past decade, many of the most important figures at the American Bar have begun to express adverse criticism of these Rules. The Durham decision is an authoritative expression of such dissatisfaction. Probably the greatest contribution that the decision makes is to permit the psychiatrist to function in the role for which his training and experience best equip him and leaves the judgments in regard to social responsibility in the hands of the court and the jury.

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Medical Service
Supreme Bench of Baltimore
Court House
Baltimore 2, Maryland

The Coroner: A Man More Sinned Against Than Sinner?

David Stewart Helberg, A.B., J.D., Cleveland, Ohio

> G.G.: If all they say is true, what a sweet place the coroner must have. I wonder if he does his duty?
>
> *A Coroner's Inquisition,* A Farce in One Act (1857).

These prophetic words, uttered by Mr. Gregory Griggs (innkeeper and one of Her Majesty's coroners for the county of Slopley) seem to represent the opinion and doubts expressed about the coroner by many observers. There is virtual unanimity of opinion concerning the value and effectiveness of the prevalent coroner system today. A typical comment has been, that "Although the United States boasts the best medical service and the most skilled medical care of any nation in the world, our own system of medicolegal investigation is one of the poorest." (1) And it has been said, on the basis of an extensive study, that we may "visualize the coroner as a poorly paid, untrained and unskilled individual, popularly elected to an obscure office for a short term, with a small staff of mediocre ability." (2) It would seem that the "ancient and honorable" office which once helped fill the King's coffers has fallen into disrepute.

However, it is neither the antiquity, *per se,* of the office nor its title (3) which brings upon it such deprecation; the problem would seem to be that the coroner's office has not fully kept pace with the changing social and technological aspects of modern life. While the coroner need no longer confiscate the property belonging to a convicted felon (4), he all too frequently is unable to apply the latest methods of de-

tecting homicide necessary to cope with the more subtle means of murder available today. The reasons for this unfortunate state of affairs will be discussed after a brief methodological consideration.

It is frequently said that, all things being equal, it is more important to have good personnel than good organization in any given governmental agency. This is particularly true in the investigation of the cause of death, under suspicious or unexplained circumstances, where personal competence is at a premium. Under any given system, outstanding investigators could undoubtedly render good service to the community. However, this assertion ought not blind us to the reality that one should not be content with whatever system is at hand simply because the "right" men could make that system operate serviceably. Whatever system the community selects should be chosen on the basis of its ability to function to the greatest advantage of society, when administered by any given quality of personnel. As a practical consideration, it will probably be found that the more soundly conceived organization will attract the better trained and better performing personnel (5).

The coroner has been under scrutiny for a long time, even though the solutions proposed for the ailments of his office have not always been the same. For example, the editor of England's *Law Journal* in 1876 admonished the legislators and other gentlemen of the realm in the following terms: "The suggestion that the coroner should be a doctor, an expert in physic, shows an entire misapprehension of the judicial function. . . . [In fact] we hold that a member of the medical profession is especially disqualified for the office of coroner. The needful qualification is judicial acumen; and for that we must go to the lawyers."

The editor gravely concludes that, "In our opinion the office [of coroner] was never more necessary than in this day; and it will continue necessary until that happy era when there is no more crime committed on the earth. . . . We, however, agree. . . that the law [dealing with the qualifications and appointment of coroners] requires amendment." (6)

The currently proposed solution to the disabilities of the coroner system is the institution of the medical examiner

system, which was first instituted in Massachusetts in 1877. Since that time, it has been adopted, with different variations, in Maine, Maryland, New Hampshire, Rhode Island, Vermont and Virginia. In addition, parts of thirteen other states currently have various forms of the medical examiner system. For example, New York City employs this system while most of the remainder of New York State does not. The essence of the medical examiner system is that the medical examiner should be a person of extensive training in medicolegal work, that he should be selected on the criterion of ability and by a competent authority on a career basis, rather than by popular election. The medical examiner should be as free as possible from political or any other kind of personal pressures, from any source, and he should have only one duty: the accurate determination of the cause of death.

In contrast, the coroner is generally elected to office for a limited time (in 38 states) (7), untrained in medicolegal work, highly susceptible to all kinds of pressure, and burdened with an excessive number of tasks.

The coroner is a man of extensive political power; in other words, he controls a good deal of patronage, being exceeded in this respect, as a rule, only by the district attorney and the sheriff (8). He is in a position to hire and fire members of his staff and also to dispense jury jobs to the "right" (properly thankful) people. "On the ballot the office is usually at the bottom of the ticket below the sheriff and clerk and other county officials. Election reflects no popular opinion whatsoever but constitutes part of the patronage which the county politicians distribute, practically unobserved, to one of their supporters." (9) Candidates for coroner frequently are nominated on the basis of class or religion or on some other political consideration. Dr. Alan Moritz has been quoted as follows: "Some coroners might say, 'Why can't an elected coroner be as good as any other kind?' Theoretically, he could be. But the chances are that if politicians control his re-election, he'll find himself doing favors for his political bosses and providing jobs for party workers."(10)

While it cannot be said that appointment rather than election is a guarantee of professional ability, it is suggested that

the probability of the jurisdiction obtaining a competent pathologist is much greater in the former case than in the latter. In three of the states favoring the medical examiner system, the governor appoints the medical examiner; in two states the state health commissioner designates the appointee; in one state, the attorney general makes the appointment; and in the final state—Maryland—the medical examiner is designated by a commission including a professor of pathology from the University of Maryland and one from Johns Hopkins University.

The qualifications of the coroner, as a rule, are notoriously low. Typically, as in Colorado:

> ". . . A Doctor of Medicine, with years of education and practical learning, signs death certificates where death is due to natural causes, and he is in attendance. The coroner, who may not have had a grade school education, or any training, signs the death certificate when the cause is doubtful, accidental, suicidal or homicidal.
>
> "To hold office in Colorado, the coroner, if he can get the vote, can be uneducated and untrained. He is not even required to know high school chemistry or college anatomy. Nevertheless, he has to make investigations, supervise inquisitions [sic: inquests (?)] and sign death certificates that affect the life and liberty of suspected persons, life and accident insurance, compensation payments, and property rights of many dying each year." (11)

It is frequently difficult to distinguish between death due to natural causes and death due to homicide. How much more difficult must it not be to do so when one is not even a physician, let alone a pathologist. It has been suggested that, "The fallacious idea exists in the minds of many in the laity and some of the medical profession that any physician, because of eminent qualification in some other branch of medicine, or any pathologist without a medicolegal training, is qualified to carry out this special type of postmortem investigation. In many cases of homicide, the inadequate postmortem examination by an incompetent or unqualified physician has been followed by a grossly erroneous interpretation of the findings." (12)

In thirty-nine states, the coroner need not even be a physician (13).

One of the most unsatisfactory aspects of the coroner system is the fact that the coroner's job seems to be peculiarly attractive to undertakers and is held by a disproportionate number of them (14). For example, as of a year ago, Wisconsin had thirty-eight coroner-undertakers in its seventy-one counties (15). Aside from his lack of medical training, the reason why it is undesirable to have an undertaker as coroner is quite apparent: the office is sought chiefly for its business advantages. Since the undertaker has initial jurisdiction over the bodies of about one-fifth of the people who die, "this gives him a prior claim upon the family [of the deceased] for conducting the funeral. The office of coroner becomes a 'feeder' for the coroner-undertaker's business." (16) It is obviously to the advantage of the coroner not to disturb the relatives of the deceased with the suggestion that an autopsy ought to be performed, especially when there is a question of insurance and/or possible incrimination involved in the determination of the cause of death.

A "compelling desire" has been noted on the part of "undertakers to embalm bodies at the earliest possible moment—embalm first and investigate later. Unfortunately, embalming, which consists principally of replacing the blood with chemical preservatives, either completely destroys or obscures many sources of information in determining the cause of death." (17) This reluctance to perform autopsies in cases falling under the coroner's jurisdiction has been confirmed in a Wisconsin study (18) which divided the coroners into three groups: first, those who were coroner-physicians, second, those who were coroner-undertakers, and third, those who were employed in a miscellany of jobs in addition to their coroner work. Of these three groups, "autopsies were ordered most frequently by the coroner-doctors and least frequently by the coroner-undertakers during 1949. Of the coroner-undertaker group 40.7% ordered no autopsies during 1949 compared with 29.5% of the coroner-other group, and 26.7% of the coroner-doctor group." (19)

It should be noted in passing that Wisconsin has apparently taken heed of the undesirable qualities inherent in the coroner-

undertaker situation and has passed legislation which prohibits funeral directors and embalmers from performing "any of the services of a funeral director or embalmer upon the body of any person whose death is required by law to be investigated by such coroner or his deputy." (20) But the violation of this statute may be punished only by a fine of not more than $50, and therefore it is still "good business" to embalm and take a chance on paying $50 in order to secure the partonage!

In contrast to the generally untrained coroner, the prime requisite of the medical examiner system is that the medical examiner is to be specially trained for his position. For example, in Maryland, "The Chief Medical Examiner and the Assistant Medical Examiners shall be licensed Doctors of Medicine, and shall have had at least two years post-graduate training in pathology." (21) It is submitted that, on the whole, the jurisdictions across the country which utilize the medical examiner system have been more successful in obtaining top-notch medicolegal workers than have the jurisdictions retaining the coroner organization.

One of the cardinal disabilities of the coroner system is the amount of political pressure which may be applied to the coroner. He must please the county politicians in order to secure a place on the party ticket, which is virtually essential because his office is usually of little interest to the voters. Aside from pressure put upon him for coroner's jury jobs (which is discussed later), there may be pressure put upon the coroner for appointments to his staff. More important, however, from the standpoint of the public interest, is the pressure which may be exerted for the suppression of evidence or against the return of homicide or suicide verdicts. In order to assure his place on the ticket, the coroner must see to it that he pleases the county politicians, who are not always motivated by the best interests of the whole community.

The medical examiner is *relatively* free of such political pressures. In most of the jurisdictions which have instituted the medical examiner system, the principle of tenure appears the same: the medical examiner holds his position as long as he performs his work well. He need not fear for his job on account of his not acceding to the wishes of the local politi-

cians. He may go about his work mindful only of the professional work expected of him. Of course, it is not here suggested that in the areas which have adopted the medical examiner system the medical examiner is absolutely free of pressures which are extrinsic to his professional occupation. Also, it is not suggested that the medical examiners may act completely without regard for public sentiments. But the medical examiner system certainly allows its personnel much greater freedom to act in the best interests of the community and according to higher standards of medicolegal work than is generally had under the coroner system.

One of the main criticisms which have been leveled at the coroner system has been that the coroner is prevented from devoting his best efforts to the job of determining the cause of death because he is burdened with a plethora of additional responsibilities. The coroner "is supposed to conduct an investigation, to follow out clues, and to find out whether there was a crime and, if so, who the criminal was." (22) As Dr. R. B. H. Gradwohl has said: "[The coroner is charged with the task of] performing the duties of judge, advocate, physician, pathologist, bacteriologist, toxicologist! The system is absurd on the face of it. Since the time of Erasmus, we have had no pantologist; therefore it is easy to understand that the incumbent to this office is never qualified to perform all the duties for which he is elected by the people and charged by the constitution of the state to carry out." (23)

As a police investigator, it is obvious that the coroner is not equipped to deal with the problems of investigating a homicide. He may go through some motions at an inquest in carrying out his "investigation," but no one really takes this procedure too seriously, especially the police, who carry on just as though the coroner did not exist. In this respect, the frequently observed newspaper notation to the effect that the inquest has been continued until the police can uncover some substantial evidence, is testimony to the value of the coroner's investigation (24).

Holding the coroner's inquest is the most important function which the coroner must perform, outside of the actual determination of the medical cause of death. (For obvious reasons, the "verdict" of the coroner's jury will include the

medical determination of death suggested by the coroner or his assistant.) This jury is composed of six men selected theoretically from the public at large, but frequently—especially in larger communities—from among the employees of the coroner's office or the unemployed members of organizations which can influence a large number of potential voters (such as the Elks or the American Legion) (25). However, some counties make special efforts to obtain a better grade of juror (26), or at least one perhaps more free to make a decision contrary to the wishes of the coroner.

Dr. Henry Turkel, the coroner of San Francisco, published, in 1953, one of the few modern defenses on behalf of the coroner system (27). He suggested that the coroner's jury serves a useful function. Turkel said:

> "These functions [of the inquest] seem to duplicate quite closely the activities of the police investigation, the district attorney's presentation of evidence to the grand jury, and the grand jury's indictment that brings the accused before a judge. Since the coroner also investigates and presents the evidence to the jury and the jury orders the accused to be brought before a judge, it should be apparent that those who wrote the laws intended that a lay body, composed of coroner and jurors, carry out these combined functions as a means of checks and balances for the various law enforcement agencies, at least in the matter of major crimes. The coroner and coroner's jury serve as an auditor and give assurance of an investigation and ultimate prosecution of crimes within its jurisdiction." (28)

This statement would seem to be unsupported by historical development. In addition, it is contrary to criminal procedure and reality.

Turkel's argument is based on a distinct procedural error. The grand jury and the coroner's jury are *not* alternative routes to trial. While grand jury action will bring the accused to trial, the coroner's jury may not do the same. If the coroner's jury renders a verdict that a particular suspect was the cause of a death under investigation, he is not then about to be tried. The suspect is then at the same point he would have been had he been brought before a magistrate at a

"preliminary examination" and there "bound-over" to the grand jury. In other words, if the coroner's jury renders a verdict accusing a suspect of a homicide, the matter is then left to the grand jury for action. If the grand jury fails to indict the accused, the coroner's jury is powerless to bring the suspect to trial. On the other hand, the grand jury may act on the case of a suspect "bound-over" by a magistrate or referred by the coroner, and in addition may begin action by its own "presentment" against the suspect (although infrequently done), thereby avoiding all intermediary steps. Thus it is seen that the grand jury and the coroner's jury do not act as checks and balances to each other. The grand jury may act without restraint on the coroner's part, but the coroner's jury may not bring a suspect to trial without the subsequent action of the grand jury.

As a further consideration, the power of the district attorney and the coroner over the grand jury and the coroner's jury, respectively, should be emphasized. The grand jury is theoretically independent in its action. But as a practical matter, since a suspect may not introduce evidence of his own volition (while the prosecuting attorney may stack the evidential cards in favor of the direction in which he wants the jury to go), the jury will usually act on the indictment in the way the prosecuting attorney intends it to.

The coroner is even more likely to control the coroner's jury than the prosecuting attorney controls the grand jury. This is due to a number of factors. The coroner is frequently either the boss of members of the jury (when they are also on his staff) or the dispenser of employment for unemployed members of the organizations which "sponsored" them; in either case they would naturally not wish to displease him. In any event, even if the jurors owed no allegiance to the coroner, he could still steer the inquest in the direction which he pleases, for example, by making the medical testimony as obtuse as necessary to confuse or "convince" the jury or by issuing subpoenas to those witnesses who were likely to testify appropriately (and not to those who were likely to render contradictory testimony).

But it is here that the coroner's jury differs in one essential way from the grand jury: at the grand jury no one

can appear unless the prosecuting attorney "invites" him, but no one needs an "invitation" to appear at an inquest. Anyone interested may appear and give the coroner's jury any information he thinks pertinent. Although such evidence given at an inquest is not generally admissible at trial (29), it may serve the distinctly useful purpose of bringing to light new facts which will permit the police to do a better job in their investigation of a death or even to apprehend the murderer (in case of a homicide having been committed). In other words, this opportunity for witnesses to appear "uninvited" affords a unique way for the police to obtain new "leads" for their investigation and is one feature not available to the grand jury. However, it is very doubtful that this aspect of the inquest is enough to justify the retention of the coroner system.

In the last analysis, the prosecuting attorney very frequently has the discretion of whether or not to bring an accused person to trial. Although, on occasion, his hand may be forced by publicity given the coroner's verdict, on the whole, the prosecuting attorney may exercise his own judgment (assuming he tries to do so) in obtaining a "true bill" or a "no bill" from the grand jury. Aside from his influence over the grand jury (and therefore indirectly over the coroner's jury), the prosecuting attorney, in many jurisdictions, may by-pass the grand jury and bring a suspect directly to trial by means of the "information." (30)

The main thrust of Turkel's argument in defense of the coroner is that, "The quality and thoroughness, as well as the scientific interest, in medicolegal investigation is similarly reflected in the per centage of autopsies done to correctly establish the cause of death." (31) He then lists statistics comparing the autopsy rates of his own and other California jurisdictions under the coroner system with the rates current in jurisdictions which operate under the medical examiner system. It appears from his statistics that the California jurisdictions perform autopsies on a much higher percentage of their medicolegal cases than the medical examiner jurisdictions. (It also should be noted that the proportion of medicolegal deaths to the total number of deaths is approximately the same among the two groups.) Turkel comments

that, "It should be apparent that any case doubtful enough to warrant a medicolegal investigation deserves an autopsy." (32) After having noted that his own coroner's office performed autopsies on 99% of the cases that came under his jurisdiction, Turkel concludes that, "It is also safe to presume that the lower the autopsy rate, the greater the number of gross errors and, therefore, grave injustices and, indeed, the less likely is the office to achieve its prime purpose and objective." (33)

The three most reasonable (but not necessarily mutually exclusive) inferences which may be derived from Turkel's statistics are: first, that despite the drawbacks of the coroner system, the California jurisdictions are doing a remarkably good job, secondly, that the medical examiners are not doing as efficient a job as they might, or, thirdly, that the thoroughness with which the autopsy work is performed in California is not as high as it might be.

It is interesting to note that the Model Post-Mortem Examinations Act issued by the National Conference of Commissioners on Uniform State Laws seems to take a view contrary to Turkel on the value of autopsies. The comment to Sec. 5 of that Act states, "It is obvious that few of the investigations here called for will result in autopsies. Where circumstances of death are clearly and authoritatively explained the medical examiner's investigation will be a quick one, often by communication with the attending physician only. Relatives of the deceased will not be disturbed. But such investigations will uncover the occasional case in which the facts call for further inquiry." (34)

It has been suggested that one of the undesirable aspects of the coroner system is that the coroner is presently an independent officer who is often in competition with the prosecuting attorney for public credit in solving homicides. Even if they belong to the same political party, there is the possibility of secret rivalry between the coroner and the prosecuting attorney. In any event, the coroner is in a position of acting largely as a contributor to the success of the prosecuting attorney, which may not be in the political best interests of the coroner. The solution to this dilemma which has been advanced is that the medical examiner or coroner (whichever

he is called) should act as the prosecuting attorney's subordinate and hold his position at the pleasure of the prosecuting attorney; this, it is suggested, would "eliminate all possible rivalry and lack of cooperation." (35) The present writer would suggest, however, that the very same result could be achieved if an independent medical examiner system were instituted, thereby establishing an office of high professional standards and not dependent on elections for tenure.

The medical examiner is not only more likely to be a man too devoted to his professional duties to stoop to political conniving, but he also would not need to do so in order to attain security in his position. As a matter of fact, his job security would depend on his performing the task of conscientiously investigating the cause of death in cases coming under his jurisdiction and deliberately *avoiding* any activity with a political objective. "The fact that the medical examiner belongs to a department which is wholly independent of the office of the district attorney is a distinct advantage in the prosecution of criminal cases, as it at least favors the delivery of unbiased medical testimony free from any dictation or influence by the prosecuting arm of the law." (36) Thus, if the medical examiner's office were not free of the district attorney's control, there would at least be a suspicion of bias which would adversely affect the conduct of the medical work, if for no other reason because the position would be less attractive to well-qualified personnel. And of even greater importance is the fact that the work of the medical examiner would be subject to pressure on the part of politicians (through the prosecuting attorney)—which was one of the most important reasons for the elimination of the coroner's office and the institution of the medical examiner system! It is apparent that, on balance, there would be no reason for changing from the coroner to the medical examiner system if the medical examiner were then put under the prosecuting attorney's thumb.

In reality, the medical examiner, in general, has *not* been put at the pleasure of the prosecuting attorney where the medical examiner system has been instituted. For example, in New York City, the medical examiner's office is quite independent of the prosecuting attorney. "The relation of

the medical examiner [in New York City] to the district attorney is that of a separate department which must cooperate with all prosecuting agencies as much as possible. [But] the district attorney cannot exercise any control over the autopsies which the medical examiner may or may not do . . . [and] is not in a position to influence the testimony of the medical examiner either directly or indirectly and this particular relationship favors impartial and unbiased testimony on the part of the medical witness." (37)

The difficulty in effecting a change from the coroner's office to the medical examiner system is due partly to the general reluctance of politicians to give up an excellent source of patronage control and partly due to the difficulties inherent in amending state constitutions. It must be borne in mind that the coroner's is a constitutional office in many of the states (38). Although statutes are usually simple to enact (if there are enough votes) and constitutions are relatively difficult to amend, neither would be an unsuperable obstacle if public sentiment were aroused over the general failure of the coroner's office to do the kind of investigative work which ought to be done and which is being done to a much more satisfactory extent under the medical examiner system. However, of late, there has been an increased interest in at least correcting some of the less desirable aspects of the coroner's office, and consideration is being given in several states to the adoption of variations of the medical examiner system.

One of the practical problems involved in the adoption of the medical examiner system is the fact that, "Only in a dozen top-size metropolitan counties is there business enough to justify full-time, year-round, adequately paid toxicologists, and other experts for first-class laboratory and autopsy work and for field investigation." (39) In view of the fact that properly trained and equipped personnel would be to a large extent idle in sparsely or even moderately populated areas, county lines must inevitably be obliterated for purposes of medical examiner work in order to make efficient use of the medical examiner system. "The volume of work done by the coroner [in a rural] county is so small that even if the coroner were replaced by a medical examiner under a modernized

form of county government, no one qualified to do expert medicolegal work could be induced to act as medical examiner." (40) But at the same time, it is recognized that, on the whole, rural communities are presently more in need of proper medicolegal services than are urban areas.

While the medical examiner system cannot work efficiently in most parts of our country if it is confined to a single county, there is nothing difficult about altering the territorial jurisdiction of the office as long as the legislative and/or constitutional problems of changing from the coroner to the medical examiner system can be solved. The system can be set up so that the area assigned to each medical examiner will depend on the relative needs of the various areas within the state (based largely on population and population density). It would be desirable to include, at the same time, some provision for altering the areas assigned as conditions change.

Of late, several voices have spoken out to the effect that the solution to the problem of obtaining sound medicolegal work lies not in changing from the coroner to the medical examiner, but in making the former more efficient. This view stems partly from the fact that it would be easier to amend state statutes to effect an improvement in the coroner's office than it would be to change state constitutional provisions. It is also in part due to the success of some jurisdictions in utilizing the coroner system to good advantage. Even Dr. Gradwohl, whose acid comment about the coroner has been noted, seems to have mellowed with time. After complimenting the Cuyahoga County (Ohio) and Los Angeles County coroners, he adds:

> "My opinion today, in contrast to my former views, is that it is possible to conduct adequate investigations under either the coroner or the medical examiner system. Mature judgment shows that it is not necessary to abolish this office in order to best serve the public; it is only necessary to see to it, by statute or local law, that efficient personnel is provided. Once this problem is solved, the most hoped-for results will follow." (41)

The argument now made by some is that if the coroner is supplied efficient and experienced personnel, proper facilities,

is relieved of the necessity of conducting police investigations and holding inquests, and is put outside the realm of political interference, then the system would work. But this is sophistry! It is like saying that if the "Witch" were transformed into "Snow White," it would make no difference if she is called "Witch." Of *course* it would make no difference! We are not concerned with the *title* borne by the office; if the "coroner's office" could be given all the improvements suggested, it would be every bit as good as the "medical examiner system," and there would be no need for a change in title. Also, it must be noted that what we have been calling "the" medical examiner system is not one system at all but a whole array of various forms with various degrees of merit. However, the important issue is How to bring about these desirable changes; and the sterility of the suggestion that the coroner system would be adequate if it did not have the *attributes* of the coroner system speaks most eloquently for itself.

It is true that the coroner system has worked well in places. But this does not meet the acid test of whether or not is has proven adequate in most jurisdictions, which it most assuredly has not. While it is undoubtedly true that it can be *made* to work well, the crucial question is How good a vehicle is the coroner system in allowing its personnel to perform properly? Why must we burden medicolegal investigators with the disabilities of the coroner system simply because we delude ourselves with the rationalization that it can be made to work IF . . . ? It is no secret that while a horse may be able to win a race carrying an additional weight, his chances are greater if he does not have to carry a handicap at all.

The problem is to bring about the relief of the medicolegal investigator from the generally burdensome effects of what is now commonly called the "coroner system." How this result is brought about is immaterial; the name to be applied to the reformed system is likewise of no importance; but what *is* important is that the bundle of characteristics now generally recognized as the "coroner system" is unable to operate efficiently and is in need of alteration. The substitution of some of the attributes of what is commonly known as the "medical examiner system" for corresponding parts of the

"coroner system" seems at this time to be highly desirable. In any event, it is idle to suggest that the coroner system would be "all right" if it could just be changed into something *else*.

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13975 Superior Road
East Cleveland 18, Ohio

Trauma as the Possible Significant Factor in the Rupture of Congenital Intracranial Aneurysms*

*Frederick D. Newbarr, M.D., and Cyril B. Courville, M.D.,***
Los Angeles, Cal.

The presence of an intracranial hemorrhagic effusion as disclosed at autopsy in an individual who has been subjected to an injury to the head is not particularly unusual. This is specifically true in cases of subdural hemorrhage (or hematoma) and hemorrhage into the substance of the brain. In such cases the mechanism, nature and severity of the cranial injury, the time interval between the injury and the onset of symptoms and the location of the effusion usually make the diagnosis clear. Occasionally, the question of "delayed traumatic apoplexy," discussed elsewhere (1), arises when a "stroke" occurs after an appreciable interval following head injury. But the problem which much more often demands critical analysis is the occurrence of fatal subarachnoid hemorrhage in the course of some stress episode during employment or incident to an altercation in which physical force was applied to the head. Such an effusion is usually found to be the result of rupture of a saccular aneurysm originating in a vessel of the circle of Willis or its immediate environs. Can rupture of this type of aneurysm actually be the

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** From the Coroner's Service, Los Angeles County, and the Cajal Laboratory of Neuropathology, Los Angeles County Hospital, Los Angeles, California.

result of direct violence to the head? If so, then in case of criminal assault, the charge of murder may be appropriately brought against the assailant. If, on the other hand, such an eventuality is not directly due to such violence, the charge would necessarily have to be modified. This question may also arise when the victim was affected while at work. Can hemorrhage under these circumstances be charged to his employment as an "industrial accident" or is it in fact "spontaneous"?

It is the purpose of this study to investigate this question in the light of the writers' observation and experience. In order to give a complete evaluation of the matter at hand, a brief review of the literature will be undertaken with respect to the relation between trauma and the formation of saccular aneurysms of the cerebral arteries. A survey will also be made as to the mechanisms of cranio-cerebral trauma with respect to subarachnoid hemorrhage. Final attention will also be given to the differential diagnosis of spontaneous *versus* traumatic effusions into the subarachnoid space. A short discussion of the legal questions which may arise in any given case will be entered into, and finally some appropriate conclusions drawn.

Can Trauma Promote the Development of a Saccular Intracranial Aneurysm?

One of the first questions which should be raised with respect to the relation between trauma and intracranial aneurysms is whether an injury to the head can be considered as the original cause of the development of the essential lesion. It is now generally agreed by most students of the problem that saccular (or as they are sometimes called "berry") aneurysms result from a congenital weakness of the muscle coat of the intracranial arteries and almost invariably at the point of their bifurcation. The theory proposed by Dandy (2) that, in some instances at least, such aneurysms are formed from incomplete obliteration of a primitive vessel, which made up part of the original vascular plexus in the embryo, does not contribute materially to the question of their traumatic origin. Some German contributors (i.e., Hiller [3]) have suggested that fractures of the cranial basis which pass through

the cavernous sinus may be responsible for the development of an aneurysm at the point of emergence of the ophthalmic artery from the internal carotid. The consensus seems to be that such a fracture with its stretching effect on the carotid siphon may rupture a pre-existing aneurysm of this type but would not very likely be its primary cause. It may be that a carotid-cavernous communication after such injuries is the actual result of rupture of a pre-existing aneurysm, but this assumption has not yet been proven. The individual lesions of this type which have been verified at autopsy seem rather to be due to tears in the wall of the internal carotid artery.

Cranial Injury and Subarachnoid Hemorrhage

Subarachnoid hemorrhage is the most common intracranial lesion after an injury to the head (4). It is therefore pertinent to this question to analyze the causes of subarachnoid bleeding in an effort to evaluate the relationship of cranial injury to rupture of an intracranial aneurysm. Subarachnoid hemorrhage incident to an "open" injury occurs at the point of penetration of the cranial vault by the foreign agent and is due to laceration of the superficial cerebral vessels. Under such circumstances, possible rupture of an aneurysm by cranial trauma is almost never in question. It is rather the occurrence of "closed" cerebral injury prior to rupture of a saccular or "berry" aneurysm that usually gives rise to the question of the possible causal relationship between the two.

Traumatic Subarachnoid Hemorrhage.—Hemorrhage into the intracranial subarachnoid space after impact of the moving head against a solid object characteristically occurs in one of two situations.* The most conspicuous location is that of the dorsolateral surface of the parieto-occipital region of one or both cerebral hemispheres. This effusion, as well as the more serious subdural hemorrhage, is usually ascribed to tearing of the superior cerebral veins where they enter the superior longitudinal sinus. Laceration of the veins at this

* Subarachnoid hemorrhage does not usually occur after a direct blow to the resting head, unless the skull is fractured and the meninges and their vessels are lacerated. It is therefore idle to discuss the potentiality of arterial hemorrhage under such circumstances.

point is attributed to excessive displacement incident to movement of the brain following the impact of the moving head. This stands out in contrast to subarachnoid hemorrhage in the basilar cisterns in case of ruptured aneurysm (Fig. 1).

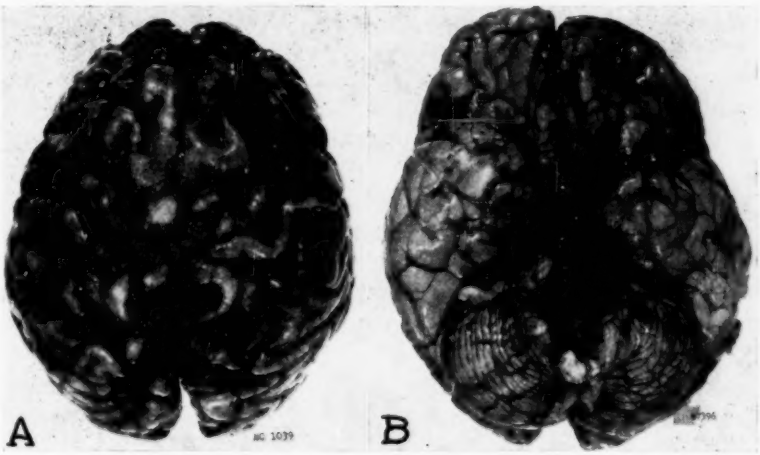

Fig. 1—A comparison between typical traumatic subarachnoid hemorrhage (A) and hemorrhage into the basilar subarachnoid cisterns incident to rupture of saccular aneurysm (B).

The second common site of traumatic subarachnoid hemorrhage is along the posterior border of the cerebellar hemispheres. Along this margin the superior and inferior cerebellar veins empty into the fixed lateral sinus. One must presume that excessive movement of the cerebellum within the posterior fossa of the skull is responsible for such hemorrhage.

These observations give rise to a dictum regarding traumatic subarachnoid hemorrhage after "closed" cranial injuries; to wit, that *traumatic subarachnoid hemorrhage in "closed" cranial injuries seems to be invariably of venous origin.*

Why Not Arterial Bleeding After "Closed" Injuries?

The possibility of bleeding from leptomeningeal arteries as a consequence of "closed" injury should not be arbitrarily

dismissed, however, if the question of aneurysmal rupture from trauma is to be thoroughly canvassed. The significant difference in the relationship of the arterial and venous systems to the skull accounts for the ready occurrence of venous and the absence of arterial bleeding under these circumstances. As explained above, the thin-walled cerebral and cerebellar veins empty into the relatively fixed dural sinuses, hence any excessive dislocation of the hemispheres from these points renders these vessels liable to laceration. On the other hand, the arteries supplying the brain have only one fixed locus—at the carotid foramen and within the cavernous sinuses. Experience has shown that only when a fracture involves the sella turcica and its environs are the internal carotids liable

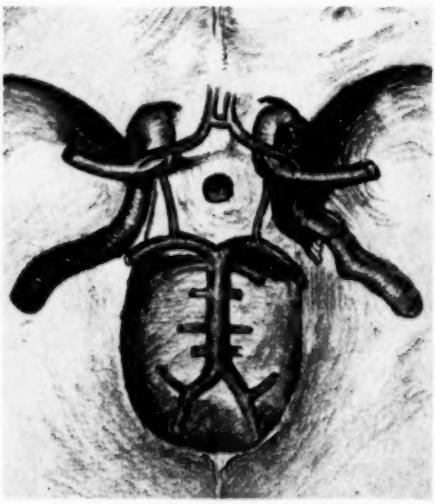

Fig. 2—Drawing of base of skull showing portions of the carotid within the petrous bone (lines) and the cavernous sinuses (dots). The intracavernous segment of this artery is most rigid part of the intracranial portion of the internal carotid and is most liable to laceration.

to stresses which can result in their laceration, leading to a carotid-cavernous communication. All other arteries of the brain, including the circle of Willis and the vertebral-basilar system, are capable of moving freely with the brain after any application of force to the skull (Fig. 2). Thus the

thick-walled arteries are not subject to severe stresses even as a result of injuries sustained with the head in motion in which movement of the brain within the skull may be considerable. The absence of bleeding at the base of the brain (that is, in the regional spaces) even after severe injuries of this type, providing no contusion or laceration of the brain has taken place, would seem to support this conclusion. In spite of these general observations, the concept of traumatic rupture of a saccular aneurysm has met with some acceptance. This conclusion is based upon the studies of Reuterwall (5), who reported 7 cases in which partial or complete rupture of the basilar artery followed cranial injury. Fraenckel (6) as well as others had also observed a case of fatal rupture of this artery. The fact that so-called "traumatic" saccular aneurysms are rarely found arising from the basilar artery but rather in the locations common to the saccular aneurysms of congenital origin should raise some doubts on this point. Such aneurysms are also noted to arise after injuries too mild in degree to rupture this vessel, which should raise serious question as to the validity of this assumption. This problem will be considered in greater detail in the following survey of the literature.

Literature on Traumatic Rupture of Intracranial Saccular Aneurysms

The subject of the relation between trauma and intracranial aneurysms is not a new one. Two phases of the question are suggested by a survey of the literature. The first deals with trauma as the essential etiological agent in the production of the aneurysm itself. The second is concerned with trauma as the exciting factor in the rupture of a pre-existing saccular aneurysm of congenital origin. It is not always easy to distinguish between these two concepts in the numerous contributions to this problem which have appeared in the past 25 years. For example, Jungmichael (7) tabulated the cases which have been reported up to the publication of his article, noting 16 examples. In this group were noted cases in which an aneurysm was discovered at autopsy months or even years after the injury. Included in this group were the cases of Killian (8) [2½ years], Oppe (9) [4 years], Fischer (10)

[5 months], Geipel (11) [10 years], Hedinger (12) [4 years], Brandess (13) [10 years], Pette (14) [½ year], Loewenhardt (15) [2 years], Hahn (16) [34 years], John (17) [¾ to 1 year], and Pawlowski (18) [Case 1, many years and Case 3, 8 years]. Harbitz (19) added two cases to this list in which an aneurysm was verified after intervals of 2¾ and 5 years. A contemporary observer, Schuurmans (20) reported a case with death from rupture of an aneurysm 3½ months after cranial injury.

Walcher (21) was more concerned with the second group of cases in which survival was measured in days rather than months or years, although in one of his cases (Case 10) trauma to the head had occurred 2 years before. In this group must be included several cited by Jungmichael (7), including those of Bruns (22) [5 days], Quast (23) [25 days], Menschel (24) [47 days], Feilchenfeld (25) [18 days], Pawlowski (18) [6 weeks], and his own case (75 days). In Harbitz's case (Case 1) [19], the survival period was 15 days. Walcher (21) included several of his own cases with survival periods of 67 days, 15 days and 7 days.

Particularly noteworthy among Walcher's cases were several that died within a few hours after onset of symptoms (Cases 4, 5, 6, 7, 8, 9 and 11) but in most of these he was doubtful that trauma played any significant role. He had evidently overlooked the case of Orth (26) in which death occurred 11 hours after injury to the head. Walcher was inclined to believe that death could occur within a few hours after injury from traumatic rupture of one of the larger arteries, thus following the lead of Reuterwall (5). He cited the cases of Meixner and Fritz (27), Wolff (28), Hoffman (29), Hey (30) and Kolisko (31) as proof.

In 1936, this matter was once more reviewed by Hval (32), who discussed the etiology of subarachnoid hemorrhage in general and traumatic aneurysms in particular. Thomas (33) also surveyed the literature on the traumatic etiology of saccular aneurysms and pointed out the various medicolegal aspects of the problem. While recognizing the possible traumatic factor in the rupture of an aneurysm, he warns against mistaking falls incident to sudden rupture of an aneurysm for their cause. He called attention to the position of Turnbull

(34), who doubted that trauma has ever been proven to be the actual cause of a saccular aneurysm.

Kahlau (35) repeated to some extent the surveys of Jungmichael (7), Harbitz (19) and Thomas (33) but noted in addition the case of Katz and Mühe (36) [rupture of aneurysm 6 months after injury] and of Lebert's 2 cases (37) with unknown survival periods. His own two cases were those of fatal subarachnoid hemorrhage after concussion (Case 1) and war wound of the head (Case 2).

More recently this problem has been discussed by Rothmell and Carrin (38), Loblich (39), and Walker (40) without adding materially to our knowledge of the subject.

Factors Necessary for Traumatic Rupture of a Saccular Aneurysm

The possible factors necessary for traumatic rupture of a pre-existing saccular aneurysm were postulated by Jungmichael (7). He stated that in the first place the injury to the head must be of a degree sufficient to rupture the wall of the aneurysm. He did not believe that actual fracture of the skull was necessary. For his second postulate, he assumed that transitory symptoms of concussion would appear immediately following the injury. Then symptoms suggesting a leakage of blood into the subarachnoid space would appear. A normal cardiovascular system before the injury was a necessary basis for these assumptions.

It is not clear why Jungmichael (7) demands a concussion picture as a necessary postulate unless its presence would warrant *per se* the assumption of an injury sufficiently severe in degree to rupture the aneurysm. It seems reasonable to believe that if the injury was severe enough to rupture the aneurysmal sac, meningeal symptoms would almost immediately obscure, if not entirely supplant, those of cerebral concussion. Moreover, since the presumption of a pre-existing normal vascular system would be difficult to substantiate on a clinical basis, it would be necessary to await postmortem verification of this postulate.

In order to satisfy the demands of a definite *traumatic* rupture of such an aneurysm in the sense that physical force

applied to the aneurysmal sac was alone responsible, the present writers would like to propose their own list of postulates: (1) the aneurysmal sac must have an unusually thin wall, thinner than the cerebral veins not injured by the force in question, (2) the application of a degree of physical force to the head sufficient to rupture the aneurysm in accord with a mechanism assuring excessive movement of the brain must be beyond question, (3) the location of the aneurysm must be such as to render it susceptible to a direct application of this force to its wall, (4) other factors leading to rupture (such as physical stress leading to rise in blood pressure) must be of secondary significance, (5) symptoms of subarachnoid hemorrhage must immediately follow the cranial injury, (6) symptoms and signs of meningeal bleeding in the living patient or location of subarachnoid hemorrhage disclosed at autopsy must be in the region where aneurysms commonly occur, and (7) demonstration by angiography or necropsy that any bleeding into the subarachnoid space was from a ruptured aneurysm, not from some other type of vascular lesion. Because this study is concerned primarily with *fatal* subarachnoid hemorrhages, the matter of demonstration of the aneurysm simplifies the problem to a considerable degree.

In order to test these postulates, a number of cases of ruptured intracranial arterial aneurysm with fatal hemorrhage were subject to critical scrutiny. These cases will be divided into three groups: (1) pre-existing aneurysms unruptured by cranial injuries, (2) rupture of aneurysm coincident with presumed cranial trauma, and (3) rupture of intracranial aneurysm occurring some time after a cranial injury. A brief report of the significant features of each case will be noted.

1. Existing Aneurysms Unruptured by Cranial Trauma

If it can be shown that pre-existent saccular aneurysms can withstand the shock of cranial injury, this fact would cast considerable doubt on the assumption that there is a causal relationship between trauma and rupture of such an aneurysm. The present writers fortunately have such a case to report herewith.

Case 1. A white man, aged 47, had sustained a fracture of the skull 16 months prior to his death. This injury was so severe as to incapacitate him because of residual headaches and dizziness. Death ultimately resulted from acute coronary occlusion. At autopsy, multiple old contusions of the left temporal and frontal lobes were found. An *unruptured saccular aneurysm* measuring 0.4 cm. in diameter arising from the juncture of the basilar and left superior cerebellar artery (Fig. 3) was also noted.

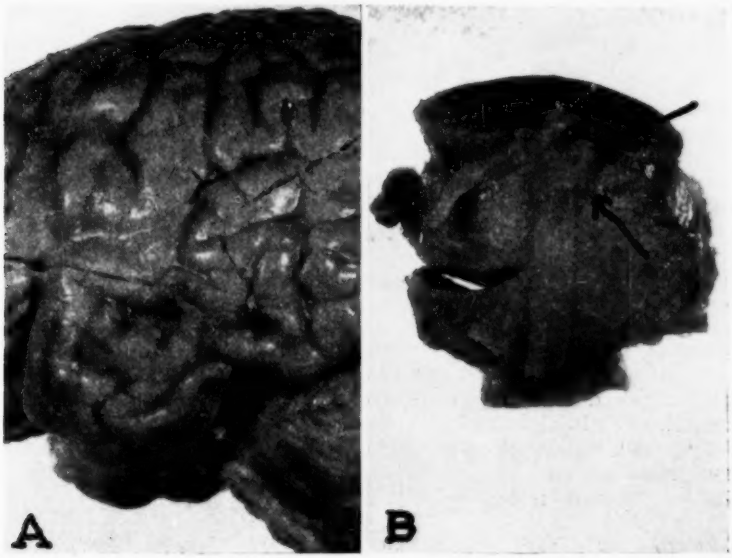

Fig. 3—Case 1. Aneurysm unruptured by moderately severe craniocerebral injury. A. Contusions of the left temporal lobe resulting from injury. B. Unruptured saccular aneurysm (arrow) at juncture of left superior cerebellar and basilar arteries.

This case would seem to indicate that a pre-existing saccular aneurysm may survive without rupture a moderately severe craniocerebral injury. It is particularly significant that the injury in this case was considerably more severe than is the situation of most instances of alleged traumatic rupture as reported in the literature, as well as in the cases described in subsequent sections of this paper.

2. *Relation of Acute Fatal Rupture of a Saccular Aneurysm to Cranial Injury*

It is precisely this question which is raised when an individual who has been subjected to a degree of cranial trauma dies from subarachnoid hemorrhage incident to rupture of an aneurysm. It is not difficult to see why a cause-effect relationship is sometimes argued by attorneys in the name of relatives of the deceased. The fact that the injury to the head may be minor in degree or entirely presumptuous is often overlooked. A brief review of a short series of cases which have come to the writers' attention will be illuminating.

Case 2. A woman, aged 50, was found dead in bed. At autopsy, abrasions of left face and ear, discoloration of tissues of scalp of left parieto-occipital area and hemorrhage in left temporal muscle were described. Gross subarachnoid hemorrhage was present in basilar cisterns. There was no fracture of skull. Bleeding was presumed to result from a ruptured aneurysm, although no actual aneurysmal sac could be demonstrated.*

Case 3. An adult male sustained multiple blows to the head in course of a fist fight. He was dead on arrival at local hospital. Autopsy disclosed superficial abrasions of face, discolorations right scalp, hemorrhage into right temporal muscle, and gross subarachnoid hemorrhage into basilar cisterns, presumably due to rupture of an aneurysm, although its sac was not actually identified (terminal portion of carotid not submitted with brain).

Case 4. A woman, aged 19, collapsed and died suddenly during an altercation. There was a question of blow to the head. Autopsy showed abrasions of skin of right hand, right knee, about the right eye and left forehead, with discoloration of left hip and left arm, as well as discoloration of tissues of scalp in the midfrontal and left occipital region. Severe subarachnoid hemorrhage in basilar cisterns was due to rupture of pea-sized, thin-walled saccular aneursym arising from juncture of left internal carotid and posterior communicating artery.

* The failure to demonstrate the aneurysmal sac in cases otherwise typical of subarachnoid hemorrhage of this etiology should not exclude them from consideration in this connection. In the experience of one of us (Courville), no sac was found in about 10 per cent of a series of over 200 cases of fatal spontaneous subarachnoid hemorrhage verified at autopsy. Whether the fact that in two of four cases (50 per cent) adequately investigated no aneurysm was found has any significance is doubtful since this group is rather small.

Case 5. An intoxicated man, aged 34, had been struck a "judo chop" on back of head by a police officer in an effort to subdue him. He collapsed within a few seconds, striking his face on pavement. He was taken to the jail and placed in a cell where he was found dead a few moments later. Autopsy showed a hypoplasia of arteries at the base with gross hemorrhage filling all the basilar cisternal spaces. No aneurysm was found but a search for such a lesion was probably too limited in extent.

Case 6. A man *ca* 60 years of age was admitted to the hospital with signs of meningeal irritation resulting from subarachnoid hemorrhage. He had had five previous episodes. He was found on the floor in an unconscious state (it being concluded that he had fallen from bed) and died shortly thereafter. He was found to have a small saccular aneurysm at the juncture of the right posterior communicating and posterior cerebral arteries which had ruptured for the seventh time.

Case 7. A man, aged 35, was engaged in a fight with another when both fell to the sidewalk. He evidently sustained a mild contusion of the scalp incident to this fall, for at autopsy an ecchymosis was found in the right occipital region. By the time the police arrived, the man was dead. At autopsy by the coroner's surgeon, a small globular aneurysm was found to have ruptured and filled the basilar cisterns and the subarachnoid space over both hemispheres with blood. The aneurysm was located at the point of origin of the posterior inferior cerebellar artery.

Of this group, Cases 2 and 3 showed only minor injuries to the tissues of the face and scalp at autopsy and were assumed to have no bearing on the fatal subarachnoid hemorrhage. In Case 4, it was even doubtful that any injury to the head had occurred and rupture of the aneurysm was attributed to rise in blood pressure incident to excitement. In Case 5, the police officer who gave the judo blow to the head of the deceased was charged with manslaughter. One of us (Courville) testified that in his opinion a blow of this sort delivered to the quiescent head was not sufficient to rupture an aneurysm or any other vessel with resulting severe (and obviously arterial) subarachnoid hemorrhage. In Case 6, it was uncertain whether any injury to the head had actually occurred or whether the fall from bed had resulted from rupture of the aneurysm. In Case 7, it was assumed that rupture had occurred incident to increase in stress occasioned by the fight.

3. Fatal Rupture of a Saccular Aneurysm an Appreciable Interval After Head Trauma

In reviewing their cases of ruptured saccular aneurysm with fatal subarachnoid hemorrhages as disclosed by autopsy performed by coroner's surgeons, it came as somewhat of a surprise to the writers that in so many cases the terminal hemorrhage developed an appreciable interval after the alleged injury to the head. Yet because some connection between the injury and the ultimate rupture of the aneurysm was considered, these cases were included in this study. A brief review of only the most salient features of each case is here included.

Case 8. A woman, aged 47, was in an automobile accident resulting in a minor injury to the face about three weeks before death. There was a history of an uncertain degree of arterial hypertension associated with hypertensive heart disease. Death in coma occurred about eight hours after sudden onset of headache. Autopsy disclosed a small ruptured saccular aneurysm arising from the left internal acoustic artery resulting in severe hemorrhage into the basilar subarachnoid space. Minimal atherosclerosis was also noted.

Case 9. A women, aged 73, sustained an injury to left ankle and right leg (uncertain history of trauma to head) in an accident 12 days before sudden loss of consciousness and death. Autopsy disclosed a ruptured saccular aneurysm of the terminal portion of the left internal carotid artery with extensive basilar subarachnoid hemorrhage. Marked atherosclerosis of the cerebral vessels was also present.

Case 10. A man, aged 42, was presumed to have had an injury to the head several weeks before. He suddenly lapsed into unconscious state and died within a few hours. Autopsy showed ruptured saccular aneurysm of anterior communicating artery with severe subarachnoid hemorrhage at the base of the brain.

Case 11. A man, aged 27, was said to be a chronic alcoholic, engaging in many fights. A possible injury to the head was said to have occurred during two recent convulsive seizures. Death came 38 days after admission to the hospital. Autopsy disclosed a thin-walled saccular aneurysm of the anterior communicating artery with evidence of previous leakage. This was associated with a more recent thrombotic occlusion of both anterior cerebral arteries and softening of the medial aspects of both frontal lobes.

Case 12. A man, aged 32, sustained multiple gunshot wounds of body in course of drunken brawl, one of which involved the cervical

spinal cord, resulting in quadriplegia. Death occurred 41 days later. Autopsy disclosed a gross hemorrhage into the basilar cisterns incident to rupture of a thin-walled aneurysmal sac arising from the lower part of the basilar artery in addition to the obviously unrelated gunshot wound of the cervical spine.

Case 13. A woman laundry worker, aged 60, had experienced a mild slap on the face three weeks before admission.* The day of admission she was seized with a severe pain, followed by a convulsive attack and coma. She died shortly after a cranial exploration for ligation of an aneurysm. A small "berry" aneurysm of the anterior communicating artery with its base occluded by a silver clip was found at autopsy.

In Cases 8 to 13 inclusive, considerable doubt existed whether any appreciable degree of injury to the head had actually taken place. Nothing further, therefore, need be said about them. Although no evidence of injury to the scalp, skull or brain was disclosed at autopsy in Case 8, cerebral concussion had probably taken place at the time of injury two weeks before death.

Case 14. A woman, aged 22, fell down a flight of stone steps with only minor injury to the head two weeks before death. She was only temporarily dazed at the time. However, headaches, drowsiness and forgetfulness occurred after the injury. A "blackout" spell followed a headache two days before death. Lapse into a semicomatose state preceded her death by six hours. Autopsy disclosed no evidence of injury to scalp, skull or brain. There was, however, a subarachnoid hemorrhage over the left cerebral hemisphere with local softening of tip of left temporal lobe. A ruptured aneurysm about one inch in diameter with an extremely thin wall was found arising from the proximal portion of the right middle cerebral artery (Fig. 4).

In this case, the connection between rupture of the aneurysm cannot be entirely dismissed, although the interval between the relatively minor injury and the second fatal rupture was rather long (approximately 7 to 8 weeks). The most significant feature in the history was to the effect that the onset of severe headaches immediately followed a fall, presumably on the back of the head. The fact that the wall

* In a similar case, a man had slapped the face of his wife found in an intoxicated condition. She collapsed shortly thereafter and died of a subarachnoid hemorrhage incident to a ruptured aneurysm. In his remorse, the husband agreed to plead guilty to the charge of manslaughter. He spent a period of time in jail for this charge, one of which he was certainly not guilty.

of the aneurysm was extremely thin, definitely demonstrable only by microscopic examination, does suggest that trauma may have played a significant role in its rupture.

Case 15. A woman, aged 57, had bumped her head about seven weeks before admission. She apparently suffered no severe degree of injury at this time but did experience rather severe occipital headaches for four days after the injury and then lapsed into coma. She was admitted to a hospital where a bloody spinal fluid led to a diagnosis of intracranial and intraspinal (presumably subarachnoid) hem-

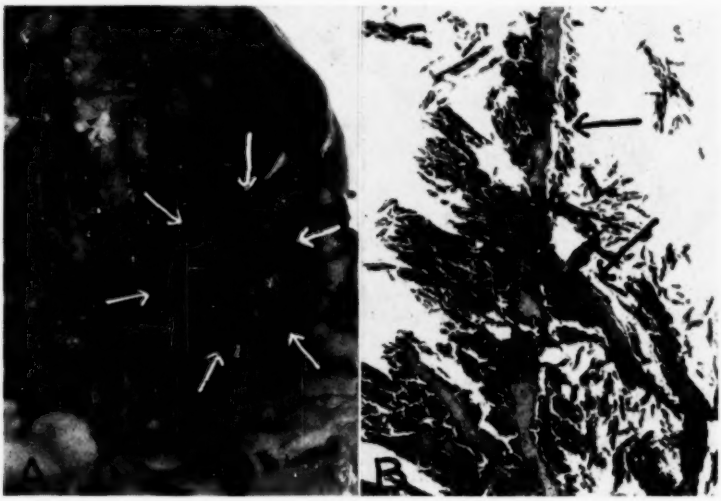

Fig. 4—Case 14. Rupture of aneurysm with extremely thin-walled sac following a minor injury to the head. A. Photograph of localized clot within a thin-walled sac, averaging less than one fifth of a millimeter in thickness. B. Section of sac enveloping friable blood clot. H & E, X 25.

orrhage. This episode was followed by an interval of freedom from symptoms for several days. A final lapse into a comatose state was followed by death several days later. Autopsy disclosed multiple hemorrhages, old and recent, into both cerebral hemispheres with both old (mild) and recent (severe) subarachnoid hemorrhages. The apparent remnants of a very thin-walled, pea-sized aneurysm was found at the juncture of the right middle cerebral and posterior communicating arteries (Fig. 5).

In the above case, a relatively young individual had fallen on her face without known cause followed by a short period

of unconsciousness one month before her death. This raises the question whether the fall might have been due to a previous rupture of the aneurysm. The persistence of headaches following the injury could be explained either by the persisting effects of concussion or meningeal irritation from a subarachnoid hemorrhage. The extremely thin wall of the aneurysm also suggested that trauma might have played a significant part in its rupture.

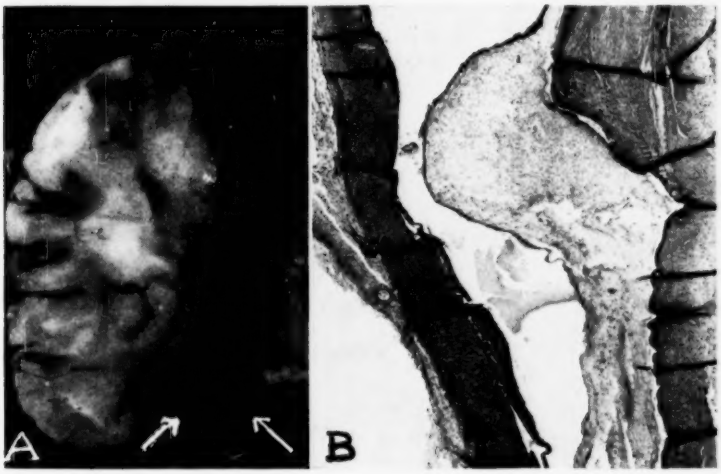

Fig. 5—Case 15. Rupture of aneurysm with hemorrhage into the temporal lobe (arrows). Other focal hemorrhages were the result of needle punctures of the brain. B. Microscopic study of aneurysm showing thin-walled sac and thrombus. The sac averaged about half a millimeter in thickness. H & E, X 25.

Case 16. A woman, aged 38, fell on her face, followed by a short period of unconsciousness about one month prior to death. After this she had recurrent severe headaches. She was admitted to the hospital with severe headache and left third nerve paralysis. Death occurred four days later. Autopsy disclosed a moderate degree of basilar subarachnoid hemorrhage from a small ruptured saccular aneurysm with a very thin wall at the juncture of the left internal carotid and posterior communicating arteries. It had ruptured into the adjacent temporal lobe (Fig. 6).

In this last instance, the circumstances of the injury to the head were not fully known. It is possible that the fall was actually due to the primary rupture of the aneurysm, rather

than the rupture being the effect of the fall. The persistence of the headaches following the injury and what seems to have been a progressive ophthalmoplegia point to some relationship between the traumatic episode and ultimate fatal rupture of the aneurysm. Perhaps the most significant finding of all was the thin-walled sac of the aneurysm which seems to be the common denominator in the writers' cases of ruptured aneurysms which appear to be consequent to trauma.

Fig. 6—Case 16. Rupture of aneurysm one month before death under uncertain circumstances. A. Small thin-walled aneurysm (arrow) at juncture of left internal carotid and posterior communicating artery. B. Microscopic preparation showing extremely thin wall of sac and apparent site of previous rupture.

It can be seen therefore, with few possible exceptions, a critical examination of the clinical history as to the time, degree and nature of the alleged injury, as well as of other possible factors, tends to exclude trauma as the significant etiological element in the rupture of the aneurysm.

The Possible Mechanisms of Traumatic Rupture of a Saccular Aneurysm

In order not to take an arbitrary stand on this question of traumatic rupture of saccular aneurysm, the writers have

suggested the following possible mechanisms by which trauma *per se* might actually be responsible for this event. In the first place, one might encounter an aneurysm with a *tissue-paper thin wall,* in which case any untoward episode, including trauma to the head, might be the final insult leading to fatal rupture. This would be especially liable to happen if the impact was sustained with the head in motion. This situation is suggested in Cases 13 and 14 of the series of cases reported herewith. Under these circumstances, it would be necessary to prove that an actual injury to the head, other than that due to the fall itself incident to the shock of sudden effusion of blood, had taken place.

The possibility of *shearing stress* as a mechanical factor in rupture of aneurysm must also be admitted. If this were the case, a mechanism indicating occurrence of two forces, one moving opposite to the other, would have to be postulated. The thrust of an aneurysm against a bony prominence resulting in a tear along the line of its attachment to the parent vessel might follow such a mechanism. In case of aneurysms located between the hemispheres (arising from the anterior communicating artery) or deep within the Sylvian fissures, this mechanism would be out of the question. It would still remain a possibility in aneurysms arising at the point of emergence of the posterior communicating from the internal carotid artery, particularly if a regional fracture of the cranial basis had occurred. Lateral impacts of the moving head might also puncture an aneurysm in this location at the juncture of the posterior communicating and posterior cerebral arteries by thrusting it against one of the posterior clinoid processes.

Two final possibilities remain. An aneurysmal sac might be ruptured by compression between two opposed surfaces, or punctured by being driven against a bony point which might thereby perforate its wall. *Rupture by compression* could occur only when the aneurysmal wall was extremely thin, which would therefore be essentially the same situation as depicted above. About the only point of origin of an aneurysm which might allow of this possibility of *rupture by puncture* would be at or near the termination of the basilar artery where the sac might be thrust against the dorsum sellae or one of the

posterior clinoid processes. The opening in the aneurysmal sac in this situation would have to be in apposition to such a prominence.

These various possibilities are illustrated in the accompanying diagram (Fig. 7).

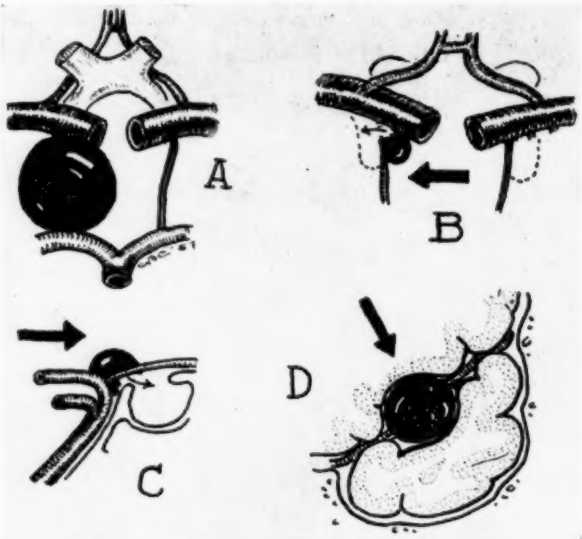

Fig. 7—Possible mechanisms by which trauma might rupture a pre-existing saccular aneurysm. A. Aneurysm with extremely thin wall subject to rupture with any change in intracranial pressure. B. Tearing along attachment of aneurysm by shearing stress (dislocation of parent vessel against anterior clinoid). C. Thrust of aneursmal sac against bony prominence (dorsum sellae). D. Compression of thin-walled sac between frontal and temporal lobes.

If the two cases (Cases 15 and 16) are again reviewed with these possibilities in mind, their true relationship to trauma can be evaluated. In Case 15, the aneurysmal sac was so thin as to be scarcely discernable to the unaided eye, being verified only by histological studies. This fact, together with a continuity of symptoms from the time of a fall on the back of the head, suggests strongly the traumatic causation of its rupture. In Case 16, a globular, thin-walled aneurysm was found between the temporal and frontal lobes, well-hidden in

the Sylvian fissure. The aneurysmal sac was indeed very thin, so thin in fact as to require microscopic examination of a local solid clot to demonstrate it. The injury, although a relatively minor affair, was immediately followed by severe headaches and coma with subsequent recovery. A second episode resulted in her death. A disclosure of both old and recent subarachnoid and regional intracerebral hemorrhages seemed to coincide with the double clinical episode. Of all cases studied in this series, the relation between trauma and hemorrhage in these two cases seems to be the most likely.

Investigation Necessary in a Fatal Case of Subarachnoid Hemorrhage Presumed to Be the Result of Cranial Injury

A review of the cases reported in the literature which have been alleged to be the result of cranial injury, as well as the writers' own experiences in this direction, suggests some necessary steps to be taken in a complete examination of an instance of suspected traumatic rupture of an intracranial saccular aneurysm. Needless to say, a critical analysis of the situation should be undertaken at once and not begun after the body has been buried and the witnesses lost sight of.

Clinical History.—In most of the reported cases, grave doubts as to the correctness of the assumption of a traumatic etiology lie in an inadequate history of the injury. In the writers' cases, there was a definite uncertainty whether the cranial injury had been at all severe or even occurred at all. A critical investigation as to the cause and nature of the alleged head injury may itself serve to exclude trauma as a cause of the fatal rupture.

In the second place, the degree of injury should be carefully looked into. It is too much to expect that minor injuries are ordinarily able to produce rupture of a saccular aneurysm unless its sac was extremely thin. Finally, the connection of significant symptoms and signs leading to death with the alleged injury is very important. Complete recovery of any posttraumatic symptoms with an interval of freedom from all discomforts should raise doubts that any causal relationship exists between the two.

The Autopsy.—The pathologist should use great care in searching for any evidence of injury to the skin, scalp or skull, noting particularly the location of such lesions. This evidence will be helpful in reconstructing the mechanism of the injury. The distribution of the resultant effusion of blood in the subdural and subarachnoid spaces is also necessary. The presence of old blood pigment which indicates a previous leakage from the aneurysm is of importance, not only to know that such leakage has occurred but also to determine the possible chronological relationship of this leakage to the injury in question. Evidence of injury to the brain itself would also prove helpful in evaluating the severity of the injury and the mechanism by which it was produced. In the light of clinical experience, such evidence may be completely lacking without disproving the assumption that the rupture was indeed traumatic. It is not enough to find the saccular aneurysm that had ruptured; it is also advisable to make note of its measurements, its precise location, the thickness (or thinness) of its wall, and the point of rupture. The relation of the aneurysm to a bony prominence at the base of the skull, especially with respect to the precise point of rupture, might also prove illuminating.

Once this evidence is available, the investigator is in a position to evaluate it in the light of present knowledge on the subject in the hope of arriving at some sort of a logical conclusion. The additional light shed on this problem in cases which have had such a complete investigation may lead us to modify our present views. For the present, however, at least the larger aspects of the problem seem to be clear.

If Trauma Is Not the Essential Cause of Aneurysmal Rupture, What Is the Responsible Factor?

The analysis of suspected cases of traumatic rupture of intracranial aneurysm considered in the previous section should make it clear that available evidence seems to disprove this assumption in the great majority of cases. But if physical force was not the primary or essential factor, what was the factor actually responsible for its rupture at that particular moment?

The problem of stress with an attendant rise in arterial blood pressure has been considered by others as the significant factor in these cases. Moritz (41) has posed the problem in the following quotation.

> "The type of arterial disease most commonly responsible for sudden hemorrhage confined to the subarachnoid space is congenital aneurysm of a superficial cerebral artery. Fatal rupture may be precipitated by a pressor episode and the question frequently arises whether or not the rupture was caused by trauma or a pressor episode. . . . As a rule the demonstration of an aneurysm as the source of intracranial bleeding constitutes evidence that at the most, trauma may have been a contributing factor to the final giving away of a structure which would probably have ruptured spontaneously."

The opposite viewpoint has been expressed by Magee (42), who holds that physical exertion plays no significant part in rupture of an intracranial aneurysm. After reviewing a series of 150 cases of spontaneous subarachnoid hemorrhage in which rupture of a saccular aneurysm was the cause, he wrote "It seemed quite clear that physical effort [or exertion] was unimportant in the etiology." This conclusion was based on the fact that in only 15 cases (10 per cent) was stress at all suggestive and in 3 of these rupture was delayed for an appreciable interval after the stress situation had passed. The same argument would hold in the case of trauma in his series, for in only 8 cases had trauma occurred. In these, the trauma was of slight degree and in some instance (playing football, etc.), the factor of stress was also associated. In only 3 of these "traumatic" cases did the bleeding start within five minutes of the traumatic episode. Magee's chief argument against stress was the fact that, in the great majority of cases, rupture of the aneurysm had occurred while the patient was relaxed and at rest, even asleep.

The conclusion of Magee is generally true, as noted in the various series of cases of aneurysmal rupture, including the group of verified cases now under investigation in the Cajal Laboratory. This means that with progressive thinning of the aneurysmal wall, a time comes when it is no longer capable of withstanding the pressure of arterial systole. Then the

rupture occurs. It seems obvious that this rupture would occur earlier than otherwise in cases of arterial hypertension or under circumstances in which arterial pressure was temporarily elevated, as with emotional tension or physical stress. An individual may continue to survive with such an aneurysm as long as his arterial blood pressure keeps below the breaking point of the aneurysmal sac. But in a moment of stress with an undue elevation of arterial pressure, particularly if the stress is marked or unduly prolonged, rupture is likely to occur.

It would appear, then, that the terminal event leading to rupture of the aneurysm is more likely to be a stress episode, resulting in an elevated blood pressure, than some purely mechanical factor incident to injury to the head. However, this would not exclude the possibility of traumatic rupture of an aneurysm under certain circumstances already considered.

Summary and Conclusions

It is well known that the fairly common congenital saccular aneurysm arising from the larger intracranial arteries may rupture and cause serious and even fatal subarachnoid hemorrhage under almost any circumstance. This may occur even when the individual is at complete rest. When such a rupture leads to fatal issue under circumstances in which physical violence to the head is suspected or in which the individual was exposed to undue stress, the question as to the actual mechanism of rupture becomes one of medicolegal concern. If violence to the head has occurred in the course of an assault or during an altercation, the further detail of the degree of criminal responsibility for the victim's death is also in question. If the blow itself was primarily responsible for the rupture, the assailant would be guilty of murder. On the other hand, if the associated stress with its attendant elevation of blood pressure was the chief factor, then manslaughter should be the verdict.

As a result of this study based upon a critical analysis of cases, the writers have come to the conclusion that physical injury to the head *per se* is very rarely the primary cause of the fatal rupture of a congenital saccular aneurysm. This is suggested in the first place by description of a case (Case 1)

in which such an aneurysm remained unruptured by a moderately severe injury to the head. If the aneurysmal sac is extremely ("tissue-paper") thin, as illustrated in two of the writers' cases, such an eventuality must be considered as possible. Moreover, if the aneurysm is so located (juncture of the internal carotid and posterior communicating arteries) as to be torn by shearing stress incident to a lateral impact of the head with gross movement of the brain, this might also be a factor in its rupture. Finally, if the aneurysmal sac could have been punctured by being thrust against some bony prominence, then trauma may also be assumed to be a significant cause. It must be stated furthermore that although death may occur some interval after an injury, this would not necessarily exclude trauma as the essential factor in rupture of the aneurysm. This is particularly true if symptoms suggestive of leakage occurred immediately after the injury and continued until the time of death, as in Case 15 of the series here reported. Otherwise, the hidden location of such aneurysms in the Sylvian fissures (at the first bifurcation of the middle cerebral arteries) or between the frontal lobes (arising from the anterior communicating arteries) with soft brain tissue in direct contact with the sac makes it most unlikely that physical violence plays any significant part in its rupture.

Analysis of many cases in which fatal subarachnoid hemorrhage had occurred in the course of a fight, even though blows to the head of the victim have been delivered, usually favors stress with its attendant elevation in blood pressure as the most important etiological factor in rupture of the aneurysm.

When aneurysmal rupture occurs in the course of employment, subarachnoid hemorrhage should ordinarily be considered as spontaneous. If, however, it can be shown that, at the moment of rupture, the individual was subject to a degree of stress not usual to his ordinary activities incident to his work which, up to that moment, had resulted in no untoward significant symptoms, then its causal relationship to his employment would have to be considered. In case of actual injury, if the impact of the head was followed immediately by symptoms of meningeal irritation incident to subarachnoid

hemorrhage, and if the aneurysm at autopsy was found to have an unusually thin wall, a cause-and-effect relationship to trauma would likewise have to be admitted.

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County of Los Angeles
Office of Coroner
Hall of Justice
Los Angeles 12, California

Differentiation of Barbiturates for Clinical and Medicolegal Purposes*

Gabriel L. Plaa, M.S., Fern B. Hall, B.A., and Charles H. Hine, M.D., Ph.D., San Francisco

Since the advent of ultraviolet spectrophotometry, methods of quantitative determination of barbiturates in blood have increased in sensitivity to such a point that the longer-acting members of the class are now detectable following repeated therapeutic doses (13). While this progress has been of particular benefit clinically, it has presented new problems to the forensic toxicologist. Since positive blood levels are now obtainable at therapeutic doses, both qualitative and quantitative aspects assume increasing importance. In addition, although the depth of depression has been found to correlate with the blood level, the blood level for comparable degrees of depression varies with the different derivatives of barbituric acid (14, 15, 16). Consequently, it is of both clinical and medicolegal importance to determine the identity of the derivative.

The identification of the derivative in tissues or stomach contents is frequently a time-consuming process. Turfitt and Bamford (2) have described a number of spot tests which may differentiate some derivatives. Melting points of crystalline barbiturate derivatives of xanthydrol or p-nitrobenzyl have also been utilized for identification (9). Recently, Büchi and Perlia (4) made an extensive study of crystal habitus, melting points, and microreactions. They found that microsublimation

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coupled with the determination of melting points was convenient for detection and identification, whereas the crystal habitus alone was scarcely sufficient. While melting-point determinations are most useful, to obtain a residue of sufficient purity oftentimes requires tedious and lengthy extractions. Goldbaum (8) has described a spectrophotometric method for identifying the more common barbiturates. While we have had some success with this method on fresh blood, it is seldom satisfactory for analyzing old, putrified samples. The chromatographic method of Algeri and Walker (1) is useful in defining the class of barbiturate present; however, the separation is not adequate to differentiate all of the barbiturates studied.

With the objective of ease and relative rapidity of performance as well as accuracy, the method to be described was developed. Essentially, it involves preliminary extraction of the derivative from an acidic aqueous medium into an organic solvent. After evaporation of the organic phase, the residue is dissolved in chloroform, applied to a filter-paper strip, and chromatographed overnight (1). After location of the spot, the substance is eluted into alkaline solution and its identity determined by its absorption spectra at a pH greater than 12.5, and pH 10.5 (8).

Procedure

Reagents:

1. Sodium tungstate, 50% w/v
2. Sulfuric acid, 6N
3. Diethyl ether, reagent grade
4. Chloroform, reagent grade
5. n-Butanol, reagent grade, saturated with 5N ammonium hydroxide (1)
6. Boric Acid—Potassium Chloride Solution: boric acid and potassium chloride are dissolved in warm water to make a 1 M solution of each (8). Let cool and stand overnight, then filter and store.
7. Sodium hydroxide: add 1 volume of saturated NaOH to about 33 volumes of distilled water. Adjust the

final normality so that two volumes of this solution added to one volume of the boric acid—KCl solution results in a buffer with a pH of 10.5.

Extractions:

Liver: Grind 100 gm. of tissue in a Waring Blendor and add distilled water to make a 500 ml. homogenate. Add 50 ml. of the tungstate solution and stir thoroughly. Add 35 ml. of sulfuric acid, slowly, while stirring. Let stand about half an hour, with occasional stirring, then filter. Extract the filtrate with two 50 to 100 ml. fractions of ether. Separate and evaporate the ether phase.

Stomach contents: Take a suitable sample (usually half the total volume). Add about 200 to 300 ml. of distilled water and filter. Acidify and extract the filtrate with two 50 to 100 ml. fractions of ether.

Chromatography:

The residue obtained from the extract is dissolved in a very small amount of chloroform, enough to wet the bottom of the beaker. With a micropipet, apply the chloroform to a centered mark about 2 cm. from the end of a 4-cm.-wide strip of Whatman No. 1 filter paper. The pipet should be chosen to deliver a very small drop (a 10-λ pipet has been found quite adequate), since the resulting spot should be about 0.5 cm. in diameter, and not exceed 1.0 cm. Multiple applications are made until it is evident that a suitable amount is present on the strip. The exact quantity cannot be defined here; with experience the analyst will quickly learn when a suitable amount is present on the strip. Too much will result in a poor resolution. The paper strip is then chromatographed by the ascending technic described by Algeri and Walker (1). Allow the chromatogram to run about fifteen to eighteen hours. Remove the paper, quickly mark the solvent front, and air dry (preferably in a hood).

Location of spot:

In most cases, the barbiturate can be located by examination of the strip under a short-wave ultraviolet light. Several light sources have been examined. Only those giving off a narrow

band around 2550 Å have been found satisfactory.* The barbiturates will show up as faint blue spots against a light background. Since the pH of the finished chromatogram is about 4.0 the strip must be exposed to concentrated ammonium hydroxide fumes to raise the pH into the range of maximum absorbancy (about pH 9.5).

If no spot can be located in this manner, place the alkalized strip against the emulsion side of a sheet of reflex photographic paper and expose to short-wave ultraviolet light. Ansco Scona Reflex paper is quite adequate. For this procedure, remove the filter and expose the paper to the wider range light source (about 15 seconds of exposure at a distance of four feet). Develop the reflex paper in the standard manner, fix, and wash. Ultraviolet-absorbing materials appear as light spots against a dark background. Blot dry, and place alongside of the chromatogram (do not allow the chromatogram to get wet). Mark the positions of the spots on the chromatogram and calculate the R_f values.

Ultraviolet absorption identification:

Cut out the spot on the chromatogram and elute the paper with 10 ml. of the sodium hydroxide solution; allow about 10 minutes for elution. A section from the bottom of the chromatogram can be eluted similarly to determine the blank contribution, or, preferably, a drug-free control strip may be run concurrently with the chromatography and the blank determined from a portion located in a position corresponding to that of the spot. After elution, pipet 3 ml. of the sodium hydroxide into a silica cell and read the absorption according to Goldbaum's method (8). Read at wave lengths 305, 270, 260, 252, 249, 247, 240, 235, 232, and 228 millimicrons on the Beckman DU spectrophotometer. Remove 1 ml. of the solution and add 1 ml. of borate-KCl solution; mix, and repeat the readings and multiply the absorption by 1.5 to correct for dilution. Calculate the absorption ratios as described by Goldbaum (8).

Standards:

Ultraviolet ratios should be determined with standard derivatives until confidence and reproducibility have been estab-

* We have used a "Mineralite" SL 2537, manufactured by Ultra-Violet Products, Inc., South Pasadena, California.

lished. In addition, standards should be run whenever the hydroxide or the borate solution is made up fresh.

Results

The results of the determinations are summarized in Table I. From this table, one sees that in the current study seven 5, 5-disubstituted barbiturate derivatives were specifically identified. Out of a total of 69 cases, only 5 could not be identified simply by this method. Twenty-four cases were corroborated by evidence found at the scene of death; in five cases the evidence was at variance with our finding, and in 40 cases no evidence was found. In six cases the evidence consisted of a mixture of amobarbital and secobarbital (Tuinal ®). Since these barbiturates partition equally well

Table I. Differentiation of Barbiturates and Comparison with Other Evidence

Barbiturate Identified	Material Tested		Other Evidence		
	Stomach Contents	Liver	Corroborated	Contradictory	None
Pentobarbital	20	4	9	4	11
Secobarbital	11	9	9		11
Phenobarbital	7	2	1	1	7
Amobarbital	4	2	3		3
Butabarbital	1	1	2		
Vinbarbital	1				
Cyclobarbital	1				
Unidentified	5	1			6
Total	50	19	24	5	40

in the chromatography system used, their complete separation is not possible under the conditions defined here. Usually a large spot results. On elution and subsequent ultraviolet absorption analysis, the resulting ratios depend upon the area of the spot eluted. If the entire spot is eluted, ratios closely resembling pentobarbital are obtained; this occurred in two cases. In two other cases, the ratios were identified as amobarbital; in one as secobarbital. In one case it was possible to elute the uppermost part of the spot and identify it as secobarbital; the lower portion was also eluted and identified as amobarbital (Table II).

Table II. Ultraviolet Absorption Ratios for Chromatographic Spot from Stomach Content Extract

	Wave Length								
	270	260	252	249	247	240	235	232	228
Upper Portion	+0.67	1	+0.36	—0.11	—0.42	—1.06	—0.91	—0.64	+0.11
Lower Portion	+0.58	1	+0.43	+0.08	—0.16	—1.01	—0.82	—0.66	—0.11

N. B. A mixture of amobarbital and secobarbital (Tuinal ®) found at scene of death.

In one case identified as pentobarbital by the ultraviolet ratios, there was conflicting evidence of amobarbital. Because blood was also available, the ratios were determined, and the pentobarbital identification was confirmed. Purification of the stomach contents yielded crystals whose melting point was 121–124° C., further confirming the identification as pentobarbital.

Of these five cases, therefore, where the evidence did not agree with our findings, two were mixtures, and one was positively identified, leaving only two unexplained discrepancies.

Discussion

The final purification of the suspected barbiturate is carried out by paper chromatography. Consequently, the initial extraction from the tissues, designed to purify the concentrate only partially, need not be elaborate. In most cases, the material obtained after this first step is not suitable for immediate ultraviolet analysis.

The chromatographic separation results in extremely pure spots, as indicated both by the lack of trailing coloring matter, and the subsequent ultraviolet ratios. While the R_f values, in themselves, are a poor means of identification, they serve to narrow down the possibilities and give the investigator an idea of what standards should be run in the ultraviolet analysis. Algeri and Walker (1) have emphasized the need for fresh solutions, control of light, and control of temperature, for reproduction of the R_f values. In some situations, such control may be impractical or impossible. Since the final resolution should not be used as the only means of identification, it is possible to carry out the chromatographic separation in the usual laboratory environment. It was found that the R_f values obtained in this manner agreed quite well with those

reported (1). Old solutions do, however, alter the results. It was found that the R_f values of barbiturates chromatographed in a three-week-old butanol-NH_4OH system increased and approached those quoted for a system of n-butanol and 1.3N ammonium hydroxide (14).

Even if the spots on the chromatogram are located by examining under ultraviolet light, it is advisable to make routine contact prints of the finished strips. First, the print constitutes a permanent record of the analysis, and becomes useful in the subsequent medicolegal procedures in the case. Secondly, it has been found that the prints occasionally reveal more spots than were located by examination under ultraviolet light. While those seen in tissue extracts are usually metabolic products, in several cases acetylsalicylic acid, acetophenetidine, and N-methylbarbiturate derivatives have been detected.

Finally, the order of sensitivity of this contact print is about equal to that amount detectable by ultraviolet spectrophotometry. This has not been the case with the other technics of localization suggested (1). One can comfortably locate about 10 micrograms in this manner. Curry (7) has reported comparable sensitivity, using a similar technic.

The ultraviolet absorption technic of Goldbaum (8), as used here, has been quite satisfactory. At least two other groups of investigators (11, 15) have also reported success with this technic. However, as pointed out by Curry (7), the method requires experience in interpretation of results. Especially when dealing with tissue extracts, one must remember the possible presence of metabolic products. It was found that if the final pH of the solution was 10.5, the ratios obtained agreed quite well with those reported in the original paper (8). Recently, Broughton (3) examined the method, and was unable to identify the various barbiturates; however, this investigator used pH 9.9 as the lower limit in order to increase the amount of barbiturate in the first ionized form. With this pH as the lower limit, we also have been unable to differentiate the derivatives. However, in view of Butler's (5) determination of the second ionization exponents, it appears that at least part of the differences observed by Goldbaum depends upon having a mixture of both ionized forms. At pH 10.5, more of a mixture is present than at pH 9.9.

The results summarized in Table I clearly illustrate the usefulness of the method. The high percentage of determinations corroborated by the evidence at the scene of death (83%) indicates its reliability. This is further demonstrated in the one case where amobarbital was found at the scene, and pentobarbital identified in the tissues and blood by ultraviolet ratios and melting-point determinations. One gratifying aspect was that most of the identifications were done "blind"; that is, the nature of the evidence was unknown at the time of analysis.

During the course of this work we had occasion to study the biotransformation of primidone (5-phenyl-5-ethyl-hexahydropyrimidine-4, 6-diol). Using the method described here, a metabolite with the same R_f value and absorbance as phenobarbital was located in rat urine (12). Butler (6) has since shown independently that primidone is oxidized to phenobarbital in man.

Summary

A method has been described for differentiating barbituric acid derivatives extracted from tissues or stomach contents. Following the initial extraction and concentration from the tissue, the derivative is purified by ascending paper chromatography. The spot is located by examination under shortwave ultraviolet light or by contact printing on reflex photographic paper exposed to ultraviolet light. Final differentiation is based on differences in ultraviolet absorbance measured at a pH greater than 12.5 and at pH 10.5. The results with 69 post-mortem samples analyzed in this manner are discussed.

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Toxicology Laboratory of the Coroner's Office, City and County of San Francisco, and Department of Pharmacology and Experimental Therapeutics, University of California School of Medicine, San Francisco 22, California.

A Microbeam X-ray Diffraction Technique of High Sensitivity

Bani R. Banerjee, M.Eng., D.Eng., Whiting, Indiana*

I. INTRODUCTION

A comprehensive review of microdiffraction techniques, in general, is followed by the description of a very powerful experimental diffraction technique consisting of the application of a microbeam X-ray source to the examination and study by diffraction of very minute amounts of "powder" crystalline particles, in the order of a few micrograms. The sensitivity and potential of this unique combination is illustrated by experiment.

This method should be particularly useful in detection-problems such as forensic studies and crime investigations. It should also be applicable to many scientific-investigations where sample-size is limited.

Review of Microdiffraction Techniques (General)

A survey of the literature on microdiffraction techniques readily revealed that despite currently increasing interest, the general availability of commercial microbeam sources and an abundance of isolated published information, mostly in foreign journals, no substantially complete and current review of this field is extant in the literature. Engstrom and Carlstrom's review (24), concerns itself mainly with the field of organic crystallography. Fournier's review (29) stresses microradiography, and is rather brief. Mackay's (65) review covers the Russian work up to 1954. Therefore, the presenta-

* Engineering Research Department, Standard Oil Company (Indiana), Whiting, Indiana.

tion of such a review as an introduction to this report was considered desirable. This review emphasizes the more recent developments, only because the older work may be found in textbooks and other standard sources.

The earlier developments in microdiffraction techniques featured fine capillary collimators, in order to improve resolution and to permit alignment of microsamples. However, these fine collimators, used in conjunction with ordinary X-ray sources, reduced the intensity of the incident X-ray beam and thereby required long exposure times, despite the small-size cameras, which were designed to minimize intensity losses. The early developments of Kratky and Mark (55), Banister and Hey (2), Fankuchen and Mark (26, 27), and Fankuchen (25) were followed by that of Chesley (12), who developed a small microcamera, featuring a method for positive positioning of the preselected portion of a fiber sample in the X-ray beam. Using a capillary collimator of 25–100 microns diameter and a 57.3 mm. diameter camera, exposure times of several hours were required. A model of this camera is available commercially. Rooksby (73) developed a 6 cm. diameter semicylindrical camera with which powder patterns from very small samples could be obtained. Fried and Davidson (30) described techniques for mounting microamounts of neptunium compounds in X-ray diffraction cameras. Recently, Cahn (8) described a back-reflection Laue camera using conical lead-glass capillary collimators to give an X-ray beam of 0.06 cm. diameter at the specimen surface. This camera was used for orientation studies of preselected areas on coarse grained uranium metal. Singer, Richards and Moxley (78) described a microcamera for the study of selected areas in the order of 35 microns diameter on a specimen, using lead-glass capillary collimators. Alignment of collimator was achieved with a fluorescent crystal and a Geiger-Muller counter.

High Intensity X-ray Sources

Since the intensity of a diffracted X-ray beam is in the order of 10^{-4} of the intensity of the incident beam, it is obvious that a substantial increase in the incident beam inten-

sity would permit an increase in sensitivity of the X-ray method. In conventional designs of X-ray tubes for diffraction, with focal spots in the order of several millimeters in dimensions, the brilliance or intensity of the X-ray source cannot be substantially increased mainly because of the heat dissipation problem in the target. With a conventional tube having a focal spot of 1 or 2 mm. in diameter and a copper anode, the maximum specific loading on the target is in the order of 70–90 watts/sq. mm.

i) Rotating Target X-ray Tubes: Two approaches to the solution of this target overheating problem have been made successfully. In the first, hollow water-cooled targets have been set in continuous motion in order to distribute the heat over a large surface area, compared with the area of the effective focus. The leviathan of such generators is the 50 kw unit employing the Muller-Clay rotor (66, 67) at the Davey-Faraday laboratory of the Royal Institute. This installation, with a recent modification by Riley (14) has an effective focal spot of 25 mm. by 0.1 mm., and a maximum safe loading of 9 kw./sq.mm. A similar generator with a focal width of 0.1 mm. and loading up to 4.4 kw./sq.mm. was constructed by Gay, Hirsch, Thorp and Kellar (34). References to earlier developments such as the mercury seal of Astbury and Preston (1), and the later developments on similar principles by MacArthur (63) may be found in standard texts. Taylor (80) has developed a medium power tube with two X-ray beams, instead of the conventional single window construction of the rotating anode tubes.

ii) Microbeam X-ray Sources: A second successful approach to cases such as in X-ray diffraction, where high brilliance or intensity rather than total output is important, consists of a reduction in the size of the focal spot dimensions. Goldsztaub (37) and Oosterkamp (69) (and later, Pines (71) in Russia) have shown that, as the radius of the focal spot r is decreased to dimensions very much smaller than the thickness of the anode, the specific loading w is inversely proportional to r, for a water cooled stationary target of given thermal conductivity. Goldsztaub (37), with a 0.2 mm. diameter focal spot, was able to achieve a specific loading of 475 watts/sq.mm.

Ehrenberg and Spear (22, 79) solved the electron-optical problem in an unique and simple fashion, by merely reversing the conventional sense of the high tension connections in the X-ray tube. They discovered that by maintaining the anode at a positive high potential, the tube casing and filament at ground potential, and the cylindrical filament shield at about +50 V bias (not critical), an excellent electrostatic focusing may be obtained, with a short filament to anode distance. Extensive investigation of the several variables showed that the focal spot size is markedly dependent on filament-grid setting and grid-to-anode distance, but not on grid bias or beam current. Much of the energy distribution was in a 20–80 microns diameter focal spot with permissible loading up to 8 kw./sq.mm.

The principle of electrostatic focusing in fine-focus X-ray tubes has been used by several workers with modifications, e. g., Eckhardt and Seifert (19) in Germany; Dudavskii (18), Kogan and Pines (54), Bublik and Pines (5, 6), Pines and Mozel (72), and Sandler (75) in Russia (the Russian school apparently prefers the conical or wedge-shaped anodes); Lambot, Vassamillet and Dejace (58) in France.

Drenck and Pepinsky (17) developed a novel diffraction tube featuring an electron emitter of niobium wire, which was heated by electron bombardment from a tungsten filament. A pinpoint target, with a focal spot of 30 microns diameter had a specific loading of 15 kw./sq.mm. This tube was designed either for continuous or pulsed instantaneous operation. Schaffs (76) reported on a cone or rod-shaped anode X-ray flash diffraction tube for pulsed operation $\sim 10^{-6}$ sec. Impulse X-ray tube operation, giving entire diffraction patterns in a single exposure was described by Schall (77). The Bublik and Pines (5) modification of the Kogan and Pines (54) tube also permitted pulsed operation.

The development of semi-microfocus X-ray tubes, such as those of Hoseman (45), Guinier et al. (41), and Ehrenberg (20, 21), are extremely interesting from the standpoint of microdiffraction techniques as applied to the small sample problem. In principle, these tubes are intermediate in characteristics and power between conventional and microbeam sources.

In connection with microbeam sources, mention must be made of three closely allied developments:

(a) the electron microprobe analyser, which uses a focused electron beam to excite X-rays from a microconstituent in a specimen. The resulting X-ray spectrum is then analysed in the usual way with a crystal analyser and direct counter set-up, e. g., Castaing and Guinier (10). Similar instruments are under construction, or were recently completed in this country, at the U. S. Steel Corporation's Edgar Bain Laboratory, at the U. S. Naval Research Laboratory and at the California Institute of Technology.

(b) the X-ray shadow microscope, e. g., Cosslett and Nixon (16); and Kato, Yamanaka and Shinoda (48). These instruments employ a point source of X-rays of less than one micron diameter, using a thin metal foil target (for theory of heat dissipation see Cosslett (15)). Shadow projection permits a resolution of 100 A, with a primary magnification of up to 100 X.

(c) the X-ray microscope constructed by means of lenses made from total reflection surfaces by Kirkpatrick and Pattee (53) some years ago. The X-ray reflection from a cylindrical surface can be made to focus in one dimension only, but by crossing two such surfaces it is possible to produce a true X-ray lens. Kirkpatrick and Pattee even suggested crossing four surfaces instead of two, and thereby improving the resolution achieved with the double lens system to 1 micron. This principle may be used to obtain a fine source of X-rays by placing a large focus X-ray source at the image plane of the focusing mirrors, with the X-rays traveling in a sense opposite to the one in the X-ray microscope. An additional advantage of this system is that the lens system can be made to self-monochromatize by adjusting the lenses for total reflection of the chosen wave length.

Henke and Dumond (42) have used the principle of total reflection to obtain a focusing X-ray camera, using a gas-filled X-ray tube (for extreme target purity of the aluminum target). The X-ray beam from the tube is monochromated and focused to a point by means of the reflectors. Thus a sample in the beam-path and film at the focal-spot produces

sharp diffraction patterns in the wave length range of 8 to 25 A, using small specimens.

Collimation of the X-ray Beam

In any X-ray diffraction experiment one must compromise between the resolution desired, the time of exposure, the grain of the X-ray film, and the focus of the X-ray tube. The mathematics of collimation geometry have been treated adequately by Bolduan and Bear (3), Huxley (46), Peiser, Rooksby and Wilson (70), and Guinier at al. (40). In addition to optimum collimation, further improvement in resolution, if necessary, may be effected by monochromatization of the incident beam as shown by Ekstein and Siegl (23), or by the point-focusing technique of Rose and Barraud (74).

Collimators used in microdiffraction techniques generally consist of pinholes, cylindrical or conical capillaries, or slits.

(a) Pinhole collimators: For pinholes down to about 50 microns diameter, the simplest procedure is to puncture lead or platinum sheets with fine tipped needles, e. g., Grundfest, Sengstaken et al. (38), and Lewis (62). Smaller pinholes down to about 12 microns diameter can be made by pressing lead around fine tungsten or other hard metal wire, e. g., MacArthur (64), Hirsch and Kellar (43).

(b) Capillary collimators: Cylindrical or conical glass capillaries have been made by various experimenters by drawing out larger bore glass tubing. e. g., Hirsch and Kellar (43), Kreger (56), Fournier (28), etc. The ease of preparation, high absorption coefficient, lack of coherent scattering from the edges, and total external reflection from the capillary walls are decided advantages in the use of glass capillaries. The total external reflection occurs over an angular range of $\beta = 2\sqrt{(1-n)}$ where n is the refractive index of the glass for X-rays. $(1-n) \approx 10^{-6}$, and β is in the order of several minutes of arc. Thus totally reflecting capillary collimators produce an increase in X-ray intensity, with an accompanying loss of resolution. The optical properties of totally reflecting collimators have been discussed by Ehrenberg (20, 21) and Kirkpatrick (52). The problem of capillary alignment and the effects of misalignment as observed by sequence-setting

photographs, have been discussed by Hirsch and Kellar (43) and Gay, Hirsch et al. (34).

(c) Slit collimators: Slit collimators, generally made from heavy metals such as tantalum, tungsten, gold, platinum or lead, are used for high resolution and low parasitic scattering. Proper slit arrangement can also make use of total external reflection of X-rays, giving an increase in intensity at a small sacrifice of resolution. Ehrenberg (21) used a slit system consisting of two polished steel cylinders separated by thin spacers. Lely and Van Rijssel (60, 61) devised an ingenious wedge collimator, with two glass plates 10 to 15 cm. long, separated 5 to 20 microns at the X-ray end and 75 to 150 microns at the specimen end. The X-rays reflecting from the walls of the collimator made a smaller angle with the central ray. Thus a divergent incident X-ray beam upon entering the collimator is rendered into a wider and more nearly parallel bundle of rays.

Microbeam Diffraction Cameras

Brasseur (4) described a photographic recording of a microbeam diffraction pattern, using the Bragg-Brentano focusing technique. Thorp (81) described a microbeam counter diffractometer technique for determining textures of very small regions of abraded crystals. Lead-glass capillaries down to 75 microns in diameter were used to detect inhomogeneties in texture on a very small scale.

Jeffery (47) described Seeman-Bohlin type focusing cameras for use with the Ehrenberg and Spear (22) tube with a useful focusing range of theta from 15 to 50 degrees. Jeffery (47) also described a flat specimen Bragg-Brentano parafocusing microcamera for photographic recording with a useful focusing range of theta from 1.5 to 45.0 degrees, using several angular settings of the specimen. Kvita, Kontsova and Umanski (57) developed focusing microcameras for use with a monochromated microbeam source in several sizes, placed in a cylindrical evacuated enclosure 30 cm. diameter by 3 cm. thick.

Kogan and Pines (54) decribed a 57.3 mm. diameter powder camera, capable of resolving all Cu K-doublets from a copper wire.

Back-reflection cameras with film oscillating or rotating in its own plane were described by Sandler (75) and Chupirin (13) for use with microbeam sources. Lewis (62) devised a direct optical method of specimen location, in his back reflection microcamera; with a source to specimen distance of 19 mm. short exposure times were claimed.

Microtechniques for the Study of Substructures

A review of microtechniques would be incomplete without reference to the extensive application of these methods to the study of subcrystal structures in metals. Cold worked or "fine grained" metals, when examined with X-ray beams of 1 mm. diameter give continuous diffraction patterns. However, if the beam diameter is reduced until the number of crystals illuminated is so small that spotty lines result, one is able to evaluate the crystallite size by counting the number of reflections or spots distributed along a Debye ring. It is obvious, therefore, that, if subcrystals in the order of 1 micron are to be counted, very fine microbeams are necessary. The numerous papers (31–33, 35, 36, 43, 44, 49–51) published from the Cavendish Laboratory, Cambridge, describe various aspects of these investigations.

Lambot, Vassamillet and Dejace (59) and later Noggle and Koehler (68) used similar techniques to study subgrains and dislocation densities respectively. Guinier (39) and Cahn et al. (7, 9) also have reported studies of this nature. Chang (11) has described a microbeam study of strain preceding brittle failure in metals.

II. THE MICROBEAM X-RAY DIFFRACTION TECHNIQUE

The method described here uses the Hilger "minifocus" X-ray source (manufactured by Hilger and Watts Ltd., London) which is based on the Ehrenberg and Spear tube design, with some modification of the electron gun. This source uses a linear filament measuring 5.5 mm. in length. The filament consists of a U-shaped tungsten wire of 0.152 mm. diameter. Electrostatic focusing, as described in Section I of this paper, gives a linear focal spot measuring 1.0 mm. by 0.1 mm.

The Hilger general purpose powder diffraction microcamera (57.3 mm. diameter) was used for recording the diffraction patterns. The combination pinhole/slit collimator was found to be quite satisfactory. Special techniques had to be developed for specimen preparation and mounting, in order to assure exact geometrical alignment with the collimating system. A special telescopic specimen alignment device (B in Figure 1) was developed for this purpose.

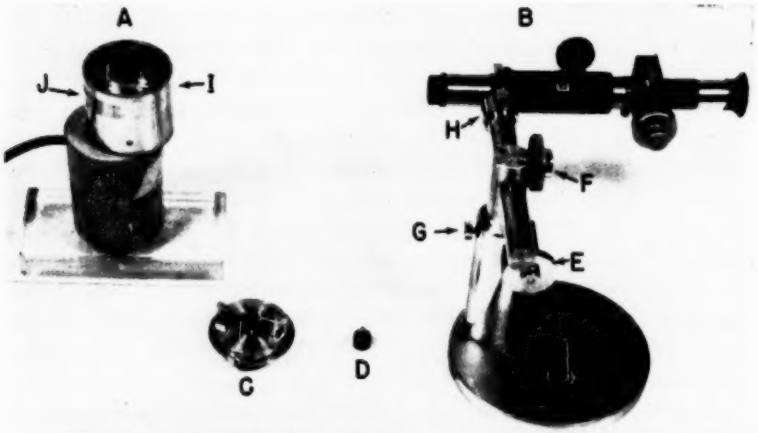

FIGURE 1. Optical telescopic alignment device B, shown in focusing position for exactly centering specimen in miniature diffraction camera A. The specimen is sighted through orifices I, J (dia. = 3 mm).
C. Collimators mounted on plate, which also forms cover for camera.
D. Radiation shield to join collimator with X-ray tube.
E. Rack and pinion control for vertical travel of microscope tube.
F. Rack and pinion control for horizontal travel of microscope tube.
G. Lock pin for vertical travel.
H. Collar controlling tilt of microscope tube.

Specimen Preparation and Mounting in Camera

The method consists of isolating the fragment or particle to be studied, and mounting it on the end of a glass or quartz capillary, which has been drawn out in a flame to a fine point. The mounting is conveniently done by first touching the fine point of the drawn capillary in a drop of Duco cement thinned with amyl acetate. When this glue-wetted capillary tip is brought near the specimen particle lying on a glass microscope slide, the specimen actually jumps to attach itself to the capillary, because of electrostatic attraction. In the case of very small samples, not discernible by the naked eye, this

operation can be aided by the use of a low power binocular microscope and the Fonbrune micromanipulator.

Exact Optical Centering of Specimen in Camera

The Hilger general purpose miniature camera and track assembly provides translation in two perpendicular directions, and rotation of the camera about its geometrical axis. It is, therefore, a simple matter to align the camera itself by taping the outlet port (J in Figure 1) with aluminum foil, to prevent a light leak into the camera, and obtaining a maximum X-ray intensity through the camera collimating system (C in Figure 1), while viewing the beam emerging from the camera on a zinc sulfide fluorescent screen. However, in order to assure the placement of a miniscule sample in the X-ray beam, it is necessary to prealign the specimen optically in the geometrical center of the camera.

A telescopic specimen alignment device (B in Figure 1) was developed to sight the X-ray ports (I and J in Figure 1), and to center the specimen in this optical path. The holes in the camera walls (3 mm. dia.) are well suited for such alignment and positioning. If the specimen is extremely small the final alignment should be made with the collimating system in place and sighting through it.

The telescopic device (B in Figure 1) consists of a microscope tube (magnification = 0.6X), provided with vertical and horizontal translations through rack and pinion gears (E and F in Figure 1). The tilt of the microscope tube also is adjustable with the collar and set screw (H in Figure 1). The cross hair in the filar eyepiece is used for exact centering.

Experimental

The technique was developed and used successfully in connection with a crime investigation concerning minute quantities of samples, undertaken at the request of the Chicago Police Department.

In this investigation, the bodies of the murdered victims were discovered quite some time after the crime was committed. Only a limited amount of material was recovered from underneath the fingernails for analysis and identifica-

tion. Microscopically-isolated fractions, measuring a few microns in dimensions, were manipulated and mounted under a binocular microscope and were positively identified by this micro-beam X-ray technique.

Table I illustrates the diffraction data obtained from three such minute samples, which were identified as iron (alpha),

TABLE I

DIFFRACTION DATA FROM THREE UNKNOWN SAMPLES, OBTAINED BY MICROBEAM-X-RAY TECHNIQUE, COMPARED WITH A.S.T.M. X-RAY STANDARD DATA

		Unknown Lines on Microbeam Diffractogram		*Standard* A.S.T.M. Data Card	
Compound Identification	hkl Index of Line	d Å	Relative Intensity	d Å	Relative Intensity
Alpha Iron					
	(110)	2.041	S+	2.027	100
	(200)	1.441	S	1.433	19
	(211)	1.175	S	1.170	30
	(220)	1.016	W+	1.013	9
Iron Oxide (Fe_3O_4)	(220)	2.95	M	2.97	60
	(311)	2.521	S	2.530	100
	(400)	2.093	M	2.097	50
	(422)	1.770	W—	1.714	40
	(333,511)	1.610	M	1.615	60
	(440)	1.474	M+	1.484	70
Silicon Dioxide (Si_1O_2)	(101)	3.361	S+	3.343	100
	(110)	2.431	W	2.458	12
	(102)	2.209	W	2.282	12
	(200)	2.106	W	2.128	9
	(201)	2.005	W	1.980	6
	(202)	1.673	W	1.672	7
	(211)	1.543	M	1.541	15
	(212)	1.381	M	1.382	7

iron-oxide (Fe_3O_4), and silica (Si_1O_2). The ASTM data on standard materials used in the identification is reproduced for comparison. The large number of diffraction lines ob-

tained from these samples, despite the small specimen-size, permitted the unique and positive identification.

To illustrate the sensitivity and potential of the instrument, a small particle of gold filing was carefully weighed in a microbalance, using a #365 quartz helix from Micro-Chemical Specialties Co. (University Avenue, Berkeley 3, California) and suspended in a microbalance tube, which in turn was placed in a thermostated chamber. The specimen was placed on a quartz pan and the weight obtained by the usual difference method. The deflection of the quartz helix was measured with a cathetometer reading directly to 0.001 mm. With this balance 10^{-7} gm. is read directly, with an estimated eighth place. The weight of the gold sample was determined accurately as 6.8 micrograms. This is equivalent to a total volume of 3.52×10^{-7}cc.

The gold particle was carefully transferred to a microscope slide and finally mounted in the diffraction camera with the aid of a binocular microscope and the Fonbrune Micromanipulator. The specimen was aligned optically in the collimator path, the camera was adjusted in the X-ray beam, and exposed to X-rays for 3 hours, using unfiltered cobalt radiation. The micro-tube was operated at 50 kv. and 100 microamp.

Six lines of K alpha reflection and the (111) K beta from the gold specimen are seen in Figure 2. The high degree of resolution of the diffraction lines is apparent. The (331) doublet was clearly resolved, although the print does not show these lines distinctly. Also it is to be noted that the lines are free from spottiness.

An exposure of the same specimen for 20 hours was made in a standard 143.2 mm. diameter commercial powder X-ray camera with the usual sealed-off large-focus cobalt-target diffraction tube, operated at 30 kv. and 10 milliamp. Even the (111) gold K-alpha line was not registered, as seen in Figure 2.

A Bradley and Jay (70) extrapolation of the parameter data from the diffractogram in Figure 2 gave an ao value of 4.084 A. This value compares favorably with Swanson and Tatge's value of 4.0786 on superpurified gold (A.S.T.M. data card file), considering the impurities in the present sample.

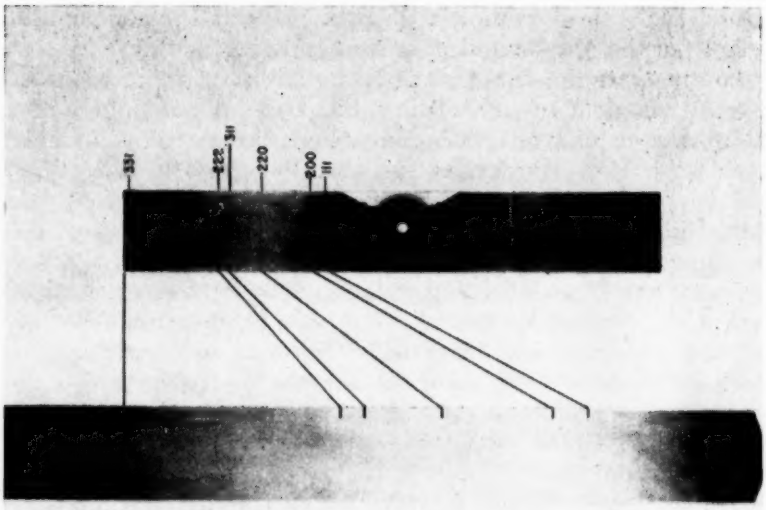

Figure 2. Top diffractogram, taken on microfocus X-ray source and micro-camera with 3 hr exposure and CoK radiation; tube at 50 KV and 100 microamp. Bottom diffractogram, taken on ordinary X-ray source with 20 hrs exposure CoK radiation; tube at 30 KV, 10 milliamp. None of the gold reflections are discernible in bottom photograph, where their expected approximate positions are marked.

III. CONCLUSIONS

The combination of a microbeam X-ray source, with suitable micromanipulation and alignment techniques has been shown to achieve a very high sensitivity for diffraction effects from extremely minute amounts of samples. These techniques can be readily set up on a relatively routine basis.

Obvious refinements of this technique would include a finer collimating system and evacuation of the camera to reduce air scatter. The telescopic device and the diffraction camera may be mounted on an optical bench for ease of operation. However, the present work clearly demonstrates the potential of

this powerful technique, both for powder and for single crystal techniques.

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Standard Oil Company (Indiana)
Whiting, Indiana

Organic Phosphorus Insecticides and Post-Mortem Blood Cholinesterase Levels*

*Charles S. Petty, M.D., Marjorie P. Lovell, B.S., and Elizabeth J. Moore, M.A.***

Many of the organic phosphorus compounds are extremely toxic substances. Some are among the most poisonous organic chemicals ever synthesized. From the point of view of the forsenic pathologist and toxicologist it is essential that a method be available to prove that a given death is due to exposure to those toxic agents.

A method of study of the blood obtained at post-mortem is presented here. This may be useful in the forensic pathology or toxicology laboratory in proving that poisoning with a member of the organic phosphate group is the cause of death. Many workers in the fields of toxicology and forensic pathology are hardly aware of the existence and availability of the organic phosphorus compounds. Therefore, a short survey of the historical development and the mode of action of these agents is included here.

Background

Organic phosphorus compounds were developed in Germany during World War II for use as war gases. These have been popularly termed "nerve gases." Following that war their

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** From the Department of Pathology, Louisiana State University School of Medicine, and the Office of the Coroner, Orleans Parish, New Orleans, Louisiana.

further development in several countries has taken two directions. One course has been toward perfecting these compounds as war gases. The other line of development has been toward the peaceful uses to which the organic phosphates might be put. These compounds have been used in research and to a minor degree in medicine, but their greatest application has been in agriculture where they have been extensively employed as insecticides.

Regardless of whether the organic phosphorus compound is employed as a war gas with human targets, or as an insecticide against insect pests, the mode of action of the agent is the same. The organic phosphorus compounds exert their toxic effect by an inhibition of a vital enzyme complex, the cholinesterase system. This inhibition of the cholinesterases is irreversible or near-irreversible. Only very small amounts of the extremely toxic organic phosphate are necessary to inhibit enough of the cholinesterases of the insect or the animal body to cause death. Because of this strong cholinesterase-inhibiting effect, these organic phosphate compounds has been termed anticholinesterases.

The cholinesterase enzyme system is complex but may be simplified for more ready consideration. In general, two main types of cholinesterases are found in the body. Pseudocholinesterase or plasma cholinesterase is formed by the liver and is found in the fluid portion of the blood. True or red blood cell cholinesterase is found in the red blood cells and in close relationship to certain nerve endings. In the nerve areas it is present in considerable quantities in the brain, in autonomic ganglia, at the end organ termination of certain autonomic nerves, and at the myoneural junctions in skeletal muscle.

Pseudocholinesterase has no known function. The true cholinesterase in the red blood cells is also of unknown function. However, the true (RBC) cholinesterase in the nervous system has a vital function. Its presence is essential for the destruction of acetylcholine formed at certain nerve endings by the stimulated nerve. It is the acetylcholine which stimulates the end organ, the skeletal muscle, or the next nerve in line at the synapse. As the acetylcholine is formed it is nearly instantaneously hydrolyzed by the true (RBC) cholinesterase

present in the same area. This rapid destruction of the acetylcholine, the compound necessary for the transmission of the nerve impulse across the synapse, or to the end organ or to skeletal muscle, is necessary to prevent prolonged action of the acetylcholine in these areas. If the acetylcholine is not destroyed the resulting effect would be similar to overactivity of those parts of the nervous system utilizing acetylcholine as a means of transmission of the nerve impulse.

The portions of the nervous system in which acetylcholine has a main role in the transmission of the nerve impulse are four in number: The autonomic ganglia (primary sympathetic), the central nervous system, the efferent nerves to the parasympathetic end organs, and the myoneural junctions in the skeletal muscle system. Thus, if acetylcholine is not destroyed in the body because of inactivity of the cholinesterase system, the resultant hyperactivity of these various portions of the nervous system will be evidenced by symptoms of overactivity of the autonomic end organs (primarily parasympathetic), the central nervous system, and the muscular system.

These symptoms are many and are best remembered if organized according to the portion of the nervous system involved. See Table 1. These are the symptoms that may be expected when the true cholinesterase is inactivated. This inhibition is the mode of action of the organic phosphates. Poisoning by an organic phosphate causes the symptoms noted. Of course, not all of the symptoms listed in Table 1 may be seen in a single case of such poisoning.

The actual cause of death in this type of poisoning is usually respiratory failure. Several factors contribute to this. A central depression of the respiratory center and paralysis of the muscles of respiration are important components. Also contributory is an overproduction of exudate by the glands of the trachea and bronchi. Excessive saliva may enter the tracheobronchial system in the unconscious individual. All of these factors are important and help cause respiratory failure. Anoxia may contribute to pulmonary edema and although of a secondary nature, this may be of great importance in the final failure of the respiratory system. Except for pulmonary edema, no findings are noted

at autopsy in cases of death due to the organic phosphorus compounds.

Organic phosphorus insecticides which are widely used in this country are most commonly recognized by their trade names or abbreviations: *T. E. P. P.* (tetraethylpyrophosphate, *Parathion* (o, o-diethyl o-p-nitrophenyl phosphorothioate), and *Malathion* [S-(1:2-dicarbethoxyethyl)-o, o-dimethyl

Table 1

Signs and symptoms of organic phosphorus poisoning

Site of Action	*Signs and Symptoms*
A. Efferent nerves to end organs. (Primarily parasympathetic)	
Pupil	Miosis (constriction).
Ciliary body	Faulty focusing, frontal headache, blurring of vision.
Conjunctiva	Injection.
Nasal mucous membrane	Congestion, rhinorrhea.
Bronchial tree	Tightness in chest, wheezing, dyspnea, chest pain, cough, cyanosis, pulmonary edema.
Gastrointestinal tract	Anorexia, nausea, vomiting, abdominal cramps, diarrhea, tenesmus, involuntary defecation.
Sweat glands, Salivary glands, Lacrimal glands	Increased sweating, salivation, lacrimation.
Heart	Bradycardia.
Bladder	Frequency, involuntary micturation.
B. Autonomic ganglia. (Primarily sympathetic)	Pallor, increased blood pressure.
C. Skeletal muscle	Fatigue, weakness, muscular twitching, fasiculations, cramps.
D. Central nervous system	Anxiety, tension, restlessness, emotional upsets, dreaming, confusion, stupor, coma (many disturbances of psychic control).

phosphorodithioate]. Other organic phosphates are used more in other countries or are newly developed compounds and not yet readily available. Of the above mentioned three agents T. E. P. P. is by far the most toxic, and Malathion the least toxic. Many accidental poisonings and a not inconsiderable number of deaths have resulted from exposure to T. E. P. P. and Parathion. Malathion has been implicated only rarely as an agent causing symptomatic poisoning, and no fatal intoxications have been reported from its use.

Both Parathion and Malathion are readily obtained as insecticides at feed stores, gardening supply houses and many drug stores. Even supermarkets stock insecticides containing these agents. The procurement of these organic phosphates should pose no problem to anyone anxious to utilize them for any means whatever. T. E. P. P. is harder to obtain as its use is generally restricted to qualified pest-control personnel.

Because of lack of definitive autopsy findings, the detection of poisoning by the organic phosphorus compounds has been the subject of investigation on three different research fronts. A specific method for the analysis of Parathion in tissues and body fluids has been developed (1). Unfortunately this method is specific for Parathion and is not applicable to other members of the organic phosphate group. Histochemical methods for the demonstration of cholinesterase in areas of local concentration have been developed and investigated from the forensic pathology point of view (2, 3). This may be a practical manner in which to approach the problem. We are now investigating this and a report will be rendered at a later date. The third line of investigation has been to determine the level of blood cholinesterases. The true (RBC) cholinesterase level should mirror the concentration of true cholinesterase in the portions of the nervous system where it is found. The organic phosphates inhibit both the true and pseudocholinesterases of the body. As the serum (pseudo) cholinesterase may vary with disease states, nutrition, etc. (4), an abnormally low serum cholinesterase is difficult to interpret. However, the true (RBC) cholinesterase of the blood is remarkably constant in a given individual in health and disease (4). An abnormally low level would be indicative of poisoning by one of the organic phosphates as these agents depress the activity of the true (RBC) cholinesterase as do no other toxins. The determination of the post-mortem level of the true (RBC) blood cholinesterase is the nature of the investigation here reported.

Method

Post-mortem subjects from which blood was taken were routine autopsy cases from the Office of the Coroner, Parish

of Orleans. From two to thirty-six hours elapsed between death and autopsy.

Blood was withdrawn from the heart by dry syringe or simply scooped out of the pericardial sac following incision of one or more of the great veins adjacent to the heart. Usually no anticoagulant was found necessary to keep the collected blood from clotting. In a few instances clots did form after the sample had been collected. This was not a deterrent factor as sufficient red blood cells for the analysis could always be obtained from the remaining fluid blood.

Samples were refrigerated within one or two hours after collection, and in most cases were subjected to analysis within a two day period after collection. Additional analyses were carried out up to three weeks after collection in some cases. This was to determine the possible effect of aging of the blood specimen on the cholinesterase level. In other cases blood from the right and left sides of the same heart was analyzed separately. In still other instances the blood samples were not refrigerated and the cholinesterase level of these and parallel refrigerated samples were determined.

The method * used is a modification of that originated by Fleisher and Pope (5). Their method was designed to determine the red blood cell cholinesterase activity in whole blood. Our modification adapts the method to red blood cells alone and thus more nearly resembles their second published method (6).

The autopsy whole blood specimen is placed in a centrifuge tube, centrifuged at 2,000 r. p. m. for thirty minutes, the supernatant fluid is removed by suction and discarded, and the remaining red blood cell mass is then diluted to two and one-half times its packed volume with an isotonic solution of sodium chloride. After thoroughly mixing the red blood cells and saline, the artificial hematocrit will be 40 per cent. The red blood cell preparation is then ready for determination of the true cholinesterase level.

The necessary solutions are essentially those of Fleisher and Pope:

* Because of space considerations only an outline of the method is given. A detailed methodology is given in (7). Copies of this can be obtained by addressing the author.

Solution A. Phosphate Buffer, 0.134 M, pH 7.2: Prepared by mixing 3 parts by volume of a solution containing 23.5 gms. of anhydrous Na_2HPO_4 per liter with 1 part of a solution containing 18.2 gms. of KH_2PO_4 per liter; pH is adjusted to 7.2 if necessary. (Refrigerate buffer and stock solutions when not in use.)

Solution B. Acetate buffer, 0.001 M, pH 4.5: 100 ml. of acetate buffer as required for Solution C may be prepared by mixing 42 ml. of 0.2 N sodium acetate (27.22 gms. per liter) with 58 ml. of 0.2 N acetic acid (11.3 ml. per liter). (Refrigerate when not in use.)

Solution C. Acetylcholine, 0.04 M: Prepared with 0.7266 gm. acetylcholine chloride (Merck) in 100 ml. 0.001 M acetate buffer (Solution B). (Refrigerate when not in use, and do not use the solution if over three weeks of age.)

Solution D. Acetylcholine, 0.004 M: One volume of solution C diluted with nine volumes of solution A. (Make daily as required.)

Solution E. Hydroxylamine hydrochloride, 2 M: Made with 27.8 gms. hydroxylamine hydrochloride dissolved in distilled water to 200 ml. (Refrigerate when not in use. Do not use if over two weeks of age.)

Solution F. Sodium hydroxide, 3.5 M: Made with 28 gms. sodium hydroxide dissolved in distilled water to 200 ml.

Solution G. Alkaline hydroxylamine: Equal volumes of solutions E and F, mixed shortly before use in a quantity required for the samples being analyzed. (Should not be used if over 30 minutes of age.)

Solution H. Hydrochloric acid: Use concentrated acid, sp. gr. 1.18, diluted with two volumes of distilled water.

Solution I. Hydrochloric acid 0.1 N: 8.3 ml. of solution H per liter.

Solution J. Ferric chloride, 0.37 M: Made with 10 gms. $FeCl_3 \cdot 6H_2O$ made up to 100 ml. with solution I.

Solution K. Saponin solution, 0.01 per cent: 0.1 gm. per liter of distilled water.

Solution L. Sodium chloride, isotonic: 9 gms. sodium chloride per liter of distilled water.

Ordinary laboratory equipment, 15 ml. Kimble Blue Line Exax centrifuge tubes, 50 microliter pipettes and a colori-

meter are needed. Either a Klett-Summerson photoelectric colorimeter with filter 54, or a Coleman, Jr. Spectrophotometer have proved satisfactory in our laboratory.

Fifty microliters of the diluted (40 per cent hematocrit) red blood cell solution is rinsed into 0.95 ml. of Saponin solution (Solution K). A second identical sample is prepared and set aside for the control determination. At zero time 1 ml. of solution D is added to the first sample, the contents of the tube are mixed and incubated at 25° C. A control tube of 1.0 ml. of solution D only is also incubated. At the end of 10 minutes 4 ml. of solution G is added to each tube. Both tubes are shaken well. After one minute, the control red blood cell solution sample is added to the control tube of solution K. Immediately 2 ml. of solution H is added to each tube followed rapidly by 2 ml. of solution J. Thorough mixing is carried out after each solution is added. The solutions in the tubes are then filtered through Whatman No. 40 filter paper and readings are made in the Klett-Summerson photoelectric colorimeter with filter 54 having previously calibrated the instrument to zero with a distilled water blank. (If the Coleman, Jr. Spectrophotometer is used, the wave length is set at 540 microns.)

To calculate the number of micromoles of acetylcholine which disappeared during incubation (the true cholinesterase activity) the following formula is used:

$$\text{Number micromoles of acetylcholine utilized by the red blood cell (true) cholinesterase} = 4\left(1 - \frac{Re}{Rc}\right).$$

Re = Colorimeter reading of experimental sample.
Rc = Colorimeter reading of control sample.

Results

The red blood cell cholinesterase level was determined in 130 autopsied cases. The average value for the entire population was 1.47 micromoles of acetylcholine utilized, with a standard deviation of 0.34, and a range of 0.54–2.38. Table 2 shows the data as obtained subdivided by color, sex, and age. No significant difference was found in refrigerated vs. non-refrig-

erated samples, and no significant fall-off in red blood cell cholinesterase activity was noted in samples periodically analyzed up to three weeks post-mortem. There was no difference in samples from the right and left sides of the heart and

Table 2

Post-mortem true (RBC) blood cholinesterase levels

Group	*No. in Group*	*Average True (RBC) Cholinesterase Level (Micromoles of Acetylcholine Utilized)*	*Standard Deviation*	*Range*
Entire population	130	1.47	0.34	0.54–2.38
Males only	97	1.52	0.31	0.74–2.38
Females only	33	1.35	0.40	0.54–2.25
White population	83	1.50	0.33	0.74–2.38
White males only	62	1.53	0.34	0.74–2.38
White females only	21	1.41	0.33	0.92–1.98
Non-white population	45	1.43	0.35	0.54–2.25
Non-white males only	33	1.50	0.28	1.00–2.17
Non-white females only	12	1.25	0.37*	0.54–2.25
Children (0–15 yrs.)	20	1.41	0.32*	0.54–1.87
Adults (over 15 yrs.)	110	1.49	0.34	0.74–2.38

* Using N–1 to calculate S. D.

the two different methods of blood collection did not affect the cholinesterase value. The cause of death did not affect the cholinesterase level as shown in Table 3. No cases of poisoning with the organic phosphorus compounds are included here.

Table 3

True (RBC) blood cholinesterase levels in various causes of death

Cause of Death	*No. of Cases*	*Average True (RBC) Cholinesterase Level (Micromoles of Acetylcholine Utilized)*	*Range*
Stab, gunshot, auto fatality	44	1.50	0.74–2.38
Myocardial infarction	13	1.46	1.10–1.84
Asphyxia (drowning-hanging)	13	1.49	0.84–2.15
Arteriosclerotic heart disease (no myocardial infarction)	11	1.57	1.06–1.98
Barbiturate intoxication	9	1.33	0.74–1.82
Pneumonitis	4	1.33	0.54–1.87
Electrocution	4	1.25	0.92–1.65
Bronchopneumonia	4	1.64	1.16–2.17
Pulmonary embolus	4	1.46	1.00–1.77
Tuberculosis	2	1.39	1.00–1.78
Miscellaneous	21	1.47	0.90–2.27

Discussion

The observed data fit with previously reported red blood cell cholinesterase activity as determined in whole blood taken from living subjects (5) and analyzed by the method used here. Grob and his co-workers (8, 9) have presented several post-mortem true (RBC) blood cholinesterase levels in non-poisoned subjects. These were determined by another method of analysis (10) thus direct comparison with our data is not possible. Grob (11) has accumulated further data on post-mortem blood samples using the same technique previously employed by his group. This has not yet been published in the open literature. However, no large series of post-mortem true (RBC) blood cholinesterase levels has previously been published.

The lack of such post-mortem data presents a problem to the forensic pathologist. He not only must be certain of the reliability and reproducibility of his findings, but he may be called upon in court to convince a jury of the validity of data that he knows to be sound on a theoretical basis only. It may be difficult to be persuasive when there is no large background of information that can be presented to lay persons.

Our data should fill this existing gap. The results show that there is no significant difference in post-mortem red blood cell cholinesterase levels even when considering age, color, and the cause of death. The difference in the red blood cell cholinesterase levels between males and females is that to be expected as has previously been reported, with the female subjects having a slightly lower average level than the males (5).

We have presented no cases of fatal poisoning with the organic phosphates in which post-mortem red blood cell cholinesterase levels would have been determined. Seven post-mortem determinations of the true (RBC) activity in fatal cases of organic phosphorus poisoning have been published (1, 9, 10, 12). In the unequivocal cases of such poisoning the true (RBC) blood cholinesterase level has been markedly reduced below normal levels. As all of these levels have been determined by other methods than that used here, direct comparison of the levels is not possible. We have encountered no such instances of fatal organic phosphate poisoning. In

our own experience in cases of near-fatal poisoning with these agents the true (RBC) blood cholinesterase level has been found depressed to near-zero (13). This is far below the minimum (0.54) level reported in the present study.

We consider this a venture into what might be termed "preventive forensic pathology." We have endeavored to anticipate the problem and provide data for a solution of it. To our knowledge, homicide has not been committed in this country by using one of the organic phosphorus compounds. But we do feel that these highly toxic agents may be so employed in the future. With the method outlined, and the data obtained, the forensic pathologist should find his task of detection of the manner of death made easier, and the erythrocyte cholinesterase levels more presentable, open to better interpretation, and more binding in court.

Summary

A survey of the forensic pathology aspects of the organic phosphorus insecticides has been presented. The true (RBC) blood cholinesterase level of 130 post-mortem subjects has been determined and found to be 1.47 micromoles of acetylcholine utilized, with a standard deviation of 0.34 and a range of 0.54–2.38. The data were subdivided by sex, color, age and the cause of death, and no significant difference was demonstrated.

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1542 Tulane Avenue
New Orleans 12, Louisiana.

Qualifications for Police Personnel *

Thomas M. Frost, B.S., M.S.I.R., Chicago, Illinois

One of the leading criteria for the creation of professional status in a particular occupation is the amount and extent of selectivity used in choosing its new members. The entrance qualifications must be such that will insure that prestige, respectability, and efficiency will be added to the occupation. Furthermore, once these qualifications are established and codified there can be no deviation, each candidate is considered solely on his merits; and he must measure up to the standards or be rejected!

No one doubts the fact that doctors, dentists, nurses, school teachers, etc. are professional people, but why? It is partially due to the selection and qualification processes used in each of these vocations. Consider the obstacles a young man must surmount before his aspirations of becoming a doctor are a reality. In addition to the many years of schooling and studying confronting him, he must prove to four different examining boards that he is qualified to join the medical profession. Initially, he is required to pass the general college entrance examination; secondly, he is required to pass the medical school examining board; thirdly, upon the completion of his academic training he must serve an internship in a recognized hospital; and finally, he must pass the state medical examination. It is only after the individual has overcome all these obstacles that he is able to call himself a true professional man.

The same situation must prevail in the field of law enforcement. It has been the "hue and cry" among police officials and police administrators for the past forty years

* This material is excerpted from a manuscript entitled, "The Selection and Training of Police Personnel," by Thomas M. Frost, B.S., M.S.I.R.

that police officers should be considered professional people. This is not a situation which can be solved by pleading—it can only be solved by the combined efforts of all police agencies, regardless of size, to establish reasonably uniform, adequate, and sensible employment qualifications.

Oftentimes, the argument is raised that the entrance standards can't be improved because the salary, the shifting working hours, the working conditions, the general public attitude and opinion of police officers make the position unattractive; and consequently it lacks the appeal and glamour which may be necessary to attract the better educated and talented young men of the community. If this situation does exist, it certainly does not have to continue. Consider for example, the Federal Bureau of Investigation which, except during times of national emergency, has no serious trouble obtaining highly qualified personnel. No one will deny that its requirements are among the highest, if not the highest, in the entire law enforcement field.

Fundamentally, the crux of the situation goes deeper than the question of hours, wages, and working conditions (this is not to infer that these factors are not essential, because they are extremely so, in fact unless they compare favorably with those of private industry many desirable candidates will be lost). The problem may, as O. W. Wilson describes it, lie in the esprit de corps of the department. This is an intangible characteristic which, nevertheless, is the true barometer of department efficiency and spirit. If the police department is demoralized, inefficient, and corrupt—no person of character will be willing to join its ranks. On the other hand, if the department is recognized as competent, courteous, just, efficient, lacking in prejudice and abounding in honesty—no reasonable standards will be considered too high. In fact, many desirable applicants may interpret this as a challenge to qualify for the position.

POLICE DUTIES

To fully understand what type of individual is best qualified to become a law enforcement officer it might be wise to consider what the position demands. The Book of Rules

and Regulations of the Chicago Police Department states that:

> "A patrolman shall maintain the preservation of the public peace, the protection of life and property, the prevention of crime, the arrest and prosecution of violators of the law, and the proper enforcement of all laws and ordinances of which the department takes cognizance. He shall perform his duties intelligently and efficiently and shall hold himself in readiness at all times to answer calls and obey the orders of his superiors. . ." (1)

> "A patrolman . . . shall faithfully, diligently, and constantly patrol the limits of his post. During inclement weather he shall equip himself with raincoat and cap cover and continue his patrol as prescribed. He shall thoroughly familiarize himself with necessary information about the city so as to enable him to render intelligent and helpful information and assistance when requested. . ." (2)

From the foregoing excerpts, it is obvious that a police applicant must be intelligent, loyal, diligent, obedient, alert, cooperative, and physically able to perform the duties and obligations required of a police officer. Thus, in order to determine the competence of a prospective police officer and whether or not he is qualified to carry out the functions and responsibilities of the police position, his qualifications must be considered in the light of three fundamental ramifications of sound selection principals: Mental Competence, Social Behavior, and Physical Condition.

MENTAL COMPETENCE

With the ever-increasing emphasis placed on scientific aids and technological criteria by police agencies throughout the nation, the era of the "uneducated cop" is gone forever. Every large police department is equipped with a scientific crime laboratory, fingerprint bureau, and records section. The polygraph operator, the police chemist, the ballistics expert, the document examiner and the fingerprint expert, have all made their importance in the field of scientific investigation realized and respected. Even the smaller departments have

accentuated specialization through the existence of the traffic safety officer, the juvenile officer, and the detective. Each of these men has done much to prevent crime and lessen the possibility of the guilty avoiding his punishment. All in all, the extent and degree of advancement in the scientific aids, the demands for intelligent leadership, and the complexity of crime detection necessitates men endowed with a high degree of intelligence.

What Is Intelligence? The term intelligence has come to mean different things to different people. In fact, it is not uncommon to find different opinions and definitions of the term among the psychologists and educators. There is considerable agreement among these authorities, however, that intelligence places considerable reliance on past experiences to assist in adapting to situations and solving of new problems. Therefore, intelligence in a police sense might be defined as the human faculty of employing past experiences in the solving of present problems accurately, effectively, and expediently.

How Is Intelligence Measured? In what way can a police agency determine whether or not a particular person has a sufficient amount of intelligence to perform the duties required of a police officer? There are two ways: First, the dangerous method of trial and error; and, second, the safe scientific way of pre-employment testing.

Many of the problems attributable to police inefficiency in the past can be directly traced to the trial-and-error method of employment selection. Under this policy of employment selection, which is still used in some communities, men are hired without sufficient pre-examining by the police department to determine their adequacy. After receiving a certain amount of instruction regarding the rudiments of the job, these men are assigned and their job performances are observed and evaluated. The officers whose job performances are not satisfactory are dropped. The dangers of this system are obvious. In addition to using poor selection methods, the department is incurring excessive expense with the constant turnover of personnel. Also, the ineffective work that

these officers render will do irreparable damage to the department in the form of arrest suits, department loss of reputation and general citizen disrespect.

Although the use of tests to predicate employment success is expensive and is no absolute guarantee that the men selected will be completely competent, it does go a long way towards eliminating a large percentage of the unsuitable candidates. One of the principal means of doing this is to use a recognized intelligence test. An intelligence test has been defined as an instrument scientifically employed to indirectly determine a person's mental ability. Generally, the items of these tests are representative of the knowledge known and understood by a sufficient cross section of the type of people for whom the test was designed. In order to obtain valid test results, the police applicants must be tested under the same conditions as was the group from whom the norms (averages) were established; and the test scores of the police applicants must be compared with scores made by people of similar backgrounds. The administration of tests and the interpretation of the test results require the services of a person of experience and skill in this area. In the smaller communities, the local high school staff can be of great help in handling this program for the police department.

All intelligence tests have norms established for various ages, educational backgrounds, professional standing, or particular occupations. In many instances, however, these adult norms are merely representative of the general population. Such norms can very well be misleading because they do not represent the group with whom the police applicants should be compared. As Professors Seashore and Ricks point out, "Norms should yield meaning in terms of the particular purpose for which the testing is done." (3) It is not sufficient to know that a police applicant has a normal amount of intelligence which is premised on national population norms; the score must be interpreted in specific employment terms as well. To obtain a valid indication of the applicant's potential the scores must be measured in terms of police norms. After all, the full value of the testing of police candidates cannot be realized unless the scores can be evaluated in terms

of norms relevant to the original purpose of testing, e.g., acquiring intelligent men to render police service. Consequently, in the listing of tests which follows, all information regarding police norms is included so that the tester may weigh his scores against other police results. It would seem with so much research yet to be done in this area that a codification of police intelligence norms maintained by a national or state agency, such as the International Association of Chiefs of Police, would help considerably to unify entrance standards and hasten police professionalization.

Suggested Suitable Tests: From among the many excellent intelligence tests presently on the market, it is felt that the following are among the best suited for police selection. This consideration is premised on two facts: first, all of these tests have adult norms; second, some of these tests have been used in police selection and therefore some police scores are available. The tests are listed in alphabetical order and do not reflect preference or merit.

The Army General Classification Test (Civilian Edition)

> This test was originally developed for extensive testing of the U. S. military forces and was released for civilian use in 1945. It is designed as a test to measure general learning abilities with emphasis on verbal comprehension, quantitative reasoning, and special thinking. This test has been used by several police departments. Norms predicated on police officers inducted into the military service is 109 AGCT score. The examination requires forty minutes working time, and can be purchased in both hand scored and machine scored editions.[1]

Otis Self-Administering Tests of Mental Abilities (Otis Employment Tests) Higher Examination

> This test has norms available for high school and college levels. Purpose of the test is to determine general intelligence level. Norms are based on general population level although this test has been used by some police departments. It is available in four different forms: A, B, C,

[1] This test is available from Science Research Associates, 57 West Grand Avenue, Chicago 10, Illinois.

D; which are equal in difficulty but differ in question matter. The test may be administered on both a twenty and a thirty minute working time. It is available in both hand and machine scored editions.[2]

S. R. A. Verbal Forms (Industrial Edition)

This test has been developed specifically for use in business and industrial selection programs. It is defined as a test of general intelligence for the selection of executives, supervisors, accountants, and clerical personnel. Norms given for police testing show a percentile average of 59 and a spread from the 38th to the 79th percentile. The test requires a fifteen minute working time and is available in hand scored and machine scored forms.[3]

Thurstone Test of Mental Alertness

This test has been designed to measure a person's capacity for acquiring new knowledge and skills. According to the author, scores have a high positive correlation with superior job performance and good school grades. "People who make high scores on the Thurstone Test of Mental Alertness learn quickly, understand more easily why things must be done in a given manner, and see complex relationships more easily . . . They have great versatility when it comes to gaining understanding and dealing with new situations." (4) The test items stress arithmetic reasoning, number series, same-opposites, and word definitions. The test requires a working time of twenty minutes and is a hand scored type test. It is available in three forms: A, B, C. Norms available are those for business executives, supervisors, salesmen, and high school students.[4]

Wesman Personnel Classification Test

This test measures the individual's power of verbal reasoning and numerical ability. The test is essentially a measure of power rather than speed. It stresses strong

[2] The test may be purchased from the World Book Company, 2126 S. Prairie Ave., Chicago, Illinois.

[3] The test may be purchased from Science Research Associates, 57 West Grand Avenue, Chicago, Illinois.

[4] The test may be purchased from Science Research Associates, 57 West Grand Avenue, Chicago, Illinois.

reasoning ability through analogy and perception of relationships. Norms are premised on high school, college, and adult employees. There is no recording of police results for this test. Testing time is twenty-eight minutes and is hand scored.[5]

How Much Intelligence Does Police Work Require? The need for intelligent people to serve as police leaders and detectives as well as recruits has long been agreed to; in fact, since the time of Vollmer's early works no progressive and far-sighted police administrator has ever thought differently. It is considered that the higher the intelligence of the recruit, all other things being equal, the more likely will be his success as a police officer. However, in the light of the many selection factors, i.e., age, physical ability, residency, education, emotional stability, etc., to say that a minimum Intelligence Quotient of 115 or 120 must be required is not in true proportion to the actual practicalness governing the entire selection program. This statement is premised on the following: first, no entrance standard should be created which is beyond the level of practicable selection. Because there are so many selection criteria involved, to require that each of these be highly restrictive will only lessen the probability of attracting competent personnel. Second, no entrance standard should be created which is not absolutely necessary. Because the general scope of police duty does not require a mental genius but rather people of average or slightly above average intelligence, there is no valid reason for preventing men of average intelligence from becoming police officers.

It is the general policy in the organizing of employment standards to establish ideal requirements which will practically guarantee job success. However, in the normal course of events, consideration must be given to the practical facts, i.e., the over-all problem of the numerous selection requirements harmoniously blending together to give the police departments competent recruits, as well as to the idealistic requirements. Consequently, the question which the personnel officer or the police chief must reconcile is: "What is a

[5] This test is available from the Psychological Corporation, 522 Fifth Avenue, New York 36, New York.

safe minimum level of intelligence for selecting personnel which will insure proper service to the community?"

The solution to this question lies in the creation of a proper cut-off score (minimum intelligence level). It should be pointed out that the most valuable norms are those which represent the ability of the group which the applicant is seeking to join. In many departments the applicants' scores are mistakenly compared with the norms of the general population. In doing this, the test results do not reflect the true measure for which it was originally administered. Valid results can only be obtained by testing experienced officers and establishing test norms from their results and thereby create a safe cut-off score.

For the most part, existing studies are either very old or rather limited in scope; and, consequently, they are not too significant. Dr. Dudycha points out several studies of police testing with the Army Alpha but some of this test data goes back to the 1920's (5). However, one recent study which he reports concerns the work of DuBois and Watson in St. Louis. Their testing of 129 applicants selected as patrolmen in St. Louis revealed an average AGCT score of 118.

More recent studies undertaken in the Chicago Police Department show a rather consistent level with the St. Louis study. In May 1956, four hundred and ninety-seven men were added to the Chicago Police Department. In September 1956, an additional four hundred and seventy-four officers were added to the Chicago Department. In comparing their academic performance with their I.Q. score it was found that those officers scoring less than 105 on the Otis Quick Scoring Mental Abilities Test and less than a 110 AGCT score on the Army General Classification Test (Civilian Edition) experienced considerable difficulty in mastering the training material. These findings compare favorably with an AGCT average of 127 for forty-two newly appointed sergeants and an Otis average of 113.3 for one hundred fifty-nine detectives attending an In-Service course. The sergeants' sampling represents approximately nine per cent of the total number of the sergeants and is a significant score because these men by means of their promotion represent employment success.

Although these studies are representative of a large mid-western city and therefore might not be completely typical of police departments in general, this data does warrant consideration. From the basis of these studies it would seem that a practical cut-off score would be 104 for the Otis and 110 for the Army General Classification Test.

EDUCATION

The amount of formal education necessary for law enforcement work is still considered a moot question. In a survey undertaken by the author (6) a few years ago it was learned that the education requisite ran the gamut from a graduate of a recognized law school for members of the Federal Bureau of Investigation to no formal education demands in one of the principal cities of the United States. It was found that in fifteen major cities, ten of them demanded that applicants be high school graduates, four cities required two years of high school, and one city specified that its applicants be, at least, graduates of grammar school. This study showed that the trend is toward cities requiring their new officers to have more formal education than they did in the past. This trend may be attributed: to the existence of compulsory education laws found in all states, the trend for college educated people to join law enforcement agencies, and to the over-all rise in the amount of formal education enjoyed by the entire population. For example, during the 1940–41 scholastic term there were 106,859 men graduated from college while during the 1951–52 scholastic term 225,981 men were graduated (7). This represents over a 100 per cent increase in college graduates.

It has been maintained by some veteran police officers (and they have presented cases to substantiate their arguments) that many successful police officers have come from families with little formal education and who, during adolescence, were exposed to the ways of the community gangs and the so-called "respectable" hoodlums. As a result of this background such officers are, according to the theory, in a much better position to anticipate gang moves, under-

stand hoodlum mores, and establish confidences among the gang element than are the more formally educated officers.

Although it can't be denied that many police officers lacking a high amount of formal education have been successful, it would be a faulty syllogism to conclude that a formal education is a detriment to police work. It is very likely that these men possessed above average intelligence.

When it is reported that the literacy of the American population is the highest in the world, it must be remembered that this includes the dishonest as well as the honest citizens. It has been pointed out in many studies of criminal behavior that there are strong bonds of organization among the criminal element. It is as Sutherland terms it "professionalization" which encompasses criminal specialization (modus operandi), gang loyalties, and alliance between the criminal and his attorney (8). It would seem reasonable to demand that the police departments at least take cognizance of the criminal standards and professionalization.

Consequently, to accept men possessing only a fifth or sixth grade education may be inviting disaster. After all, a police officer must be able to write an intelligent report, express himself coherently and commandingly in court and before a belligerent crowd, and possess sufficient mental ability to make spontaneous rational decisions.

On the other hand, except for certain specialized positions, i.e., polygraph operator, document examiner, etc., a college education is not essential. At least at the present time such educational standards should not be established unless there is a superabundance of college men in the community. In fact, if a police department found itself staffed with a large amount of college men, it would soon delegate them to routine post and patrol duty. These men, realizing that they are equipped mentally for jobs more demanding and faced with the prospects of slight chance of promotion, would soon become demoralized and prove of little value to the department. Certainly any job which can be performed well by non-college personnel offers little challenge to an ambitious college graduate.

It would seem from the foregoing analysis of the situation that a middle position toward the solution is not only a

legitimate compromise but also an adequate one. It would appear that a proper education standard would be a high school graduate or its equivalent which would be determined by local standards as some cities are prevented by statute from altering requirements. By the adoption of this education standard, the door would be closed to most men who would retard police progress and yet at the same time a sufficient number of college graduates would filter in to supply the ranks with enough men to advance to positions of leadership and command.

In general, the high school graduate is much better prepared for public service than is the non-graduate. Certain courses, such as history, federal government, civics, and sociology, do much to condition and train the mind in the proper community attitudes and beliefs; courses in rhetoric and public speaking train the individual to think, write, and speak in a logical, concise, coherent, and commanding manner. Another important advantage to the establishment of a high school education requirement is that because of the almost unlimited educational opportunities available today, the failure of a young man to complete high school is generally indicative of a lack of self-determination, mental ability, or far-sightedness.

SOCIABILITY

Within the framework of the term "sociability" lies the consideration of the police applicant's personality and character defined in terms of police necessity.

Due principally to the multifarious ramifications of police work there are few vocations which necessitate such a harmonious blending of stable personality and unreproachable character as does the law enforcement profession.

Because personality is a person's individual manifestation of and reaction to all attitudes, behaviors, beliefs, desires, emotions, and temperaments of human beings it is a unique identifying characteristic. There are no two people who possess the same total personality. Because of this uniqueness it is not possible to define a specific personality type which would best suit a police officer.

Consider the problem of emotional stability. All people possess in varying degrees the emotional drives of fear and anger. Because these personality traits are normal human responses to either a mental or physical stimulation it would be impossible to attempt to hire men lacking them. The essential point to remember is that these emotions are controllable. Therefore, a qualified police officer must be able to control his emotions rather than attempt to avoid the stimulation. Emotional control is extremely important in police work where an individual is exposed to trying and exasperating situations almost every day. Such clichés as: "He knows no fear," "He has nerves of steel," and "He has ice water in his veins" have been applied to military leaders and police officers alike. However, this external appearance of calmness and strong presence of mind in the face of adverse conditions are attributable to emotional control and not to lack of fear. All men have experienced fear but it is not a dangerous attribute until it blinds our judgment and hinders our actions. A police officer experiences fear when he enters a darkened building late at night to apprehend a gunman but he controls his fear and performs his assignment. In fact, the presence of fear in this situation perhaps cautions the officer to proceed with care and therefore actually aids him. On the other hand, if a police officer fails to take proper action because of fear of his adversary or the forces of political pressure then he lacks the proper emotional stability and should not be a member of the police department.

Therefore, the personnel officer or the police chief should bear the following principles in mind while evaluating the police applicant's personality:

1. What are the most desirable and the least desirable personality characteristics for police work?
2. Which of these desirable and undesirable personality characteristics does the applicant have?
3. Do the desirable or undesirable characteristics predominate?
4. Will the possession of the dominant characteristics help to make this applicant a satisfactory police officer?

It is necessary, therefore, to determine which personality characteristics are desirable and which are not desirable for

police work. The list below sets out the majority of salient elements which should be considered when evaluating police candidates:

Desirable	*Undesirable*
Ambition	Indifference
Conscientiousness	Laziness
Confidence	Complaining
Persistence	Lacking in Self-Assurance
Courageousness	Lacking in Moral Principles
Responsibility	Submissiveness
Friendliness	Prejudice
Leadership	Frustration
Honesty	Emotional Instability
Social Adaptability	Mental Abnormality
Sound Judgment	Timidity
Tactfulness	Hostility
Unbiased	Defiance
Obedient	
Cooperative	

Methods Employed to Determine Type of Personality: The methods generally recommended for use in determining proper personality adjustment are: 1. Personality Tests, 2. Interviews, 3. Rating Scales, 4. Projective Techniques.

Personality Tests: The easiest approach to personality testing is the use of the paper and pencil test or as it is better known the questionnaire type test. Its advantages are: it is easy to administer, it can be scored very quickly, and it is the most ideal type of test when working with large groups. Its principal disadvantage lies in the inability of of the administrator to prevent the testee from giving what he considers the desired answer rather than the answer which will accurately reflect his personality. If the test contained an item which asked: "Are you shy in crowds?" the applicant might answer, "No," even though he may be a very reserved person, because he knows that police officers must not be timid or submissive.

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Rating Scales: A Rating Scale is a schedule of characteristics desired, together with varying degrees of weight ranging from excellent to poor. It is used to assist the interviewer to make accurate evaluations of individuals interviewed for employment purposes.

Interview: This situation brings the applicant face to face with a ranking member of the police department. It establishes a highly personal contact and does much to render evaluation accuracy.

Projective Technique: This type of personality evaluation has very limited use in the police field as it necessitates highly skilled test administrators to score and interpret the test. The Rorschach Test (ink blot test) and the Apperception Test are the most outstanding in this field.

CHARACTER

It is a fundamental fact that any type of employment involving a place of public trust, public confidence, fiduciary relationship and respect by its very nature demands that its members possess fine characters, good reputations, and are respected members of their community. Needless to say, law enforcement lies within this category.

The present day free-thinking liberalism which has endeavored to overcome all forms of control and restriction, including moral and ethical standards, has manifested its presence in many levels of the government service as well as in the economic sphere. Numerous scandals concerning misfeasances and nonfeasances, in addition to other types of pharisaical conduct, have been the essence of many news reports. Sad though it is to relate, the law enforcement field has not been without its share of ignominious notorieties in this regard and has suffered through its bribery shakedowns, unlawful searches and seizures, and assaults to compel confessions.

As a result of situations such as these, police departments throughout the nation must exercise the greatest care and prudence in the selection of their personnel. They must

employ a thorough character investigation in order to guarantee, insofar as is humanly possible, prevention of future occurrences of a similar nature.

AGE

It is to the utmost advantage for the police departments to restrict their selection of police personnel to men in their twenties, preferably between twenty-one and twenty-five years. Only in situations of dire emergency should men over the age of twenty-eight be accepted.

One of the most essential reasons for recruiting young men lies in the fact that they possess considerably more years of potential service to the community thereby assuring a safer investment both from the cost of selection and training and from the cost of sick benefits and pension rights. The younger man is more apt to select police work as a career as he has had less time to pursue other occupations than has the older man. Because of the short duration between the termination of his academic training and the commencement of his police career, the young man possesses a sharper and more alert mind thereby making the training and conditioning program more effective. Younger men are not as settled in their habits and thus are able to adjust to the semi-military structure and to conformity with the rigidness of police rules and regulations. Because police duty accentuates sound physical conditioning, departments should be constantly filling their ranks with young men who possess greater physical strength and endurance. It is a foregone conclusion that unless highly qualified and desirable men are selected at an early age they will quickly be taken away by the attractiveness of private industry.

In some quarters, it is questioned as to whether or not a person of twenty-one years is old enough to assume the duties and responsibilities of police work. If proper investigation and pre-testing, similar to the military forces in selecting officer candidates, is employed and such a program shows that the person is mentally capable, the chronological age should not be considered a hindrance.

On the other hand, to hire men over their middle twenties may be courting disaster. Older men are more settled in their habits and therefore it is more difficult to indoctrinate them into the military discipline and rigors of police work. Older men are not as receptive to learning as are younger men. The older men may have experienced considerable job failure elsewhere. It would seem that men in their thirties who are not already permanently established employment-wise may be maladjusted, lack the qualifications of job success, and in general constitute a poor employment risk. Effective police agencies cannot burden themselves with people who were failures in the business world and are only joining the police service to insure themselves of employment security. Finally, older men are poor risks not only from the physical standpoint but also from an actuarial point of view as they are more apt to be seeking sick benefits and pension benefits sooner.

The accompanying table shows the age requirements for police applicants in many of the principal cities of the United States. The average minimum age of the seventeen cities is 21.12 years and the average maximum is 31.24 years. This

TABLE I

AGE REQUIREMENT FOR POLICE APPLICANTS IN PRINCIPAL CITIES OF THE UNITED STATES *

Age		
Minimum	Maximum	Cities
20	29	Berkeley
21	27	Chicago, Detroit
21	29	Cleveland, Portland
21	30	Baltimore, Cincinnati, Los Angeles, Newark, Omaha
21	31	Buffalo
21	34	Philadelphia
21	35	Memphis, San Francisco
21	45	Kansas City
22	31	St. Louis
23	29	Madison
21.12	31.24	Average

* Based upon the results of survey made by the author in 1951.

rather substantiates the trend toward the recruitment of young men for this essential public service; although in some cities there still remain considerable opportunities for older men.

Although almost all cities have established an age limitation of one sort or another, there is still a major "loophole" which enables older men to join police agencies in many cities. Although civil service laws of most cities require that applicants be within certain specified age limitations, generally this requisite is applicable only at the time of the examination or on the date that the individual files his application. Therefore, if an applicant is close to the maximum age when he takes the examination and is placed close to the bottom of the eligible list when it is posted (it may take two or three years before he is called for appointment) in such a circumstance it is quite possible for him to be in his thirties by the time he joins the police department.

Some cities, such as San Francisco, California, and Portland, Oregon, have prevented this situation from occurring by adding a provision to the age requirement. This provision stipulates that persons having reached a particular maximum age, even though they are still on an eligible list, are no longer under consideration for appointment.

RESIDENCY

From the literature available concerning the necessity for, or the abolition of, the residency requirement in the selection of police personnel, the consensus of opinion among the experts (generally, this opinion does not prevail among Civil Service Administration officials or police officials) is that the requirement should be abrogated.

Oftentimes the residency issue develops as the aftermath of a police scandal or is the by-product of some type of police survey. It appears that whenever this circumstance presents itself, the investigators invariably reason that if nonresidents were permitted to join the department the conditions would not be so depraved. Just one step further is the idea that a residency waiver would reduce the political sovereignty so often allegedly associated with the hiring of police officers.

This point is beyond consideration in cities where the Civil Service Commission's integrity is unquestioned. The Chicago Crime Commission in 1953, while investigating the alleged intrigue between the Chicago Police Department and local politicians said, "Political assistance in seeking employment in the Chicago department is quiescent."

Because it is so essential for police agencies to execute the utmost care and prudence in screening police applicants, a residency requirement should be mandatory. All applicants should be required to establish residency in the city or the county for at least one year prior to filing an application. The only justification for suspending this rule would be if it seriously hinders the department from obtaining highly qualified personnel.

The strongest point in favor of a residency restriction is that it makes the character investigation a much simpler and concise procedure. This is a very essential feature on the local level where the police budget and manpower are highly limited. A nonresident's character investigation is both difficult and costly to a local department. It is possible, however, due to the strong bond of mutual admiration and cooperation existing between the county sheriff's office and the local city police department to insure a thorough character investigation by the sheriff's staff of those applicants residing in the county but outside the city limits.

Investigations of applicants residing beyond the county line must be left to the whim and fancy of another department. Because of the lack of control of this investigation by the local department there can be no assurance that a thorough and complete investigation will be conducted. This constitutes a very dangerous procedure and contradicts sound employment screening principles.

The majority of American cities require that police applicants be permanent residents of that city whose department they are endeavoring to join. The residency duration varies slightly from city to city. In Detroit, applicants must establish residency in the state for one year prior to the examination date, whereas San Francisco demands a five-year city residency accrued immediately preceding the date of the examination. Portland, Oregon, requires that applicants for its

police force be residents of "Multnomah, Washington, or Clackamos counties, except those who have or will have completed a four year college course in Police Administration (by July 1, 1951) and are residents of Oregon or Washington." (9) Chicago, Philadelphia, and Kansas City require a one-year city residency while Pittsburgh and St. Louis demand two years of residency. Los Angeles and San Diego are among a few major cities which permit non-state residents to compete in their examinations.

PHYSICAL CONDITION

In addition to the consideration of a police applicant's age, character, education, intelligence, and personality; a police agency should realize the importance of a sound body as well as a sound mind. Height, weight, physical condition and agility standards must be adhered to in order to complete a sound recruitment program.

Height and Weight: A police officer should be better than average height, preferably not shorter than 5′ 9″. The reasons for this are obvious. A taller officer commands more respect from a belligerent group or an unruly person who might otherwise openly defy a smaller officer. A taller officer adds prestige and dignity to the uniform, and can be better seen in crowds or while directing traffic. There is also a bit of psychology connected with the taller officer's size which may lessen the possible need of physical force in arresting situations. A maximum standard of 6′ 4″ should also be made so as to lessen the possibility of hiring men suffering a glandular disorder.

These standards are strongly substantiated by the requirements of sixteen cities as they existed in 1951. Nine cities required that police officers must be at least 5′ 8″ tall and the other seven established their minimum at 5′ 9″. The minimum height is 5′ 8½″. The maximum mean computed from the same cities is 6′ 4.3″.

The correct weight should be determined by means of insurance height and weight tables or existing military force medical standards. In any event, it should conform favorably

with the normal weight for an individual's height. It may be wise, however, to permit the examining physician some discretion in determining the over-all suitability of the candidates.

Physical Condition: Because police service necessitates performance in all types of weather and oftentimes requires physical force to defend oneself or overcome an adversary, too much stress cannot be placed on the intrinsic importance of a sound medical examination of all applicants. The performance hazards constantly place a considerable portion of police personnel on the medical rolls. The legitimate percentage should not be deliberately increased by hiring personnel who are not in top physical condition.

Departments should require that applicants be in excellent health, be free from latent physical defects, possess the necessary muscular co-ordination and strength to perform their duties in a capable manner. Such things as 20/20 vision; proper color perception; freedom from disease, hernia, varicose veins; proper respiration and circulation all merit special attention by the examining physician.

SUMMARY

The discussion of the maximum personnel requirements has been purposely avoided because much has been ably written and solidified on this proposition already. It does seem, however, that the concentration on these maximum requirements does constitute a serious omission to the solution of the police personnel officer's immediate dilemma—he knows that if he establishes the maximum requirements he will have too few candidates and if he ignores these requirements can he afford to gamble on his selection choices?

It seems necessary to interpret the maximum standards as the ideal standards which all departments must strive for and eventually employ. However, being practical men, we must weigh our problems in the light of conflicting demands and reach a solution which will be both sound and feasible!

Consequently, the personnel officer is immediately interested in a set of safe minimum standards upon which he can

predicate his selection program. Just where is he to draw the line? Where is he to consider the danger point? A criterion must be found so that he can say with accuracy and evidence—"This is enough, if I hire men beyond this point, I'm gambling with the community's safety!"

Let us consider the following as the absolute minimum requirements for a police officer:

A police candidate should have, at the very least, an Intelligence Quotient of 104 if the Otis Quick Scoring Mental Abilities test is used, and 110 if the Army General Classification test is employed. Both these scores carry an identical percentile rank of 65 (in the absence of studies regarding the correlation of these test scores, percentile ranking is the easiest and most accurate method of test result comparison; if other tests are used, the results can be interpreted in terms of these percentile rankings). In addition, the candidate should successfully pass a general police qualification test.

The prospective officer should be a high school graduate or possess an equivalent amount of education and experience; such as, a former service man who has passed the General Educational Development Test.

The candidate must be endowed with a personality which will ensure a healthy mental attitude toward police situations and people of various racial, religious, and cultural backgrounds.

In order to ensure proper indoctrination and adjustment, as well as maximum service, police departments must require that applicants be between twenty-one and twenty-five years of age.

Only in situations of dire emergency should candidates be considered who are not permanent residents of the county for at least one year prior to filing an application. In all situations, candidates must establish an immediate and continuous county or city residency after filing an application. This is a very important element which must be adhered to in order to accurately investigate the candidate's background accurately and completely.

Because police service necessitates performance in all types of weather and at times requires force to carry out the duties

of the office, police candidates must be subjected to and pass a rigid physical and medical examination.

In stipulating the foregoing requirements, it is firmly believed that they are the absolute minimum which any police agency can safely employ. For a police chief or personnel officer to go below any of these, regardless of his motives, is to take a serious risk with his department's efficiency and his community's safety. Of course it will be said that some have done so and not suffered immediate repercussions; but by way of analogy, a man may drive an automobile with faulty brakes and not have an accident, but do we consider him a prudent man?

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Training School
Chicago Police Department
1121 South State Street
Chicago 5, Illinois

Book Reviews

ALCOHOLISM: BASIC ASPECTS AND TREATMENT, edited by Harold E. Himwich, M.D. An A.A.A.S. and A.P.A. joint symposium. 212 pp. $5.75, 1957 AAAS, Washington, D.C.

This is a carefully organized presentation of a vexatious problem, by a group of twenty-nine authorities on the subject of alcoholism.

In his preface the editor indicates that the aim of the symposium was the acquisition and dissemination of information as an aid in understanding this disease. This objective is attained in the 212 pages which comprise the volume. The papers are well written, some with statistical illustrations and with appropriate references.

As in others of the series issued by these sponsors, the preface and the introduction serve to arouse the readers' interest and, seemingly, from there on the volume is finished in no time at all. Practically all phases of alcohol in its relation to the human economy are covered, and all pertinent basic facts are discussed. Treatment is not neglected, but no new discoveries are uncovered.

As one who has been plagued by the many problems of the alcoholics, this reviewer cannot subscribe to the optimistic 40 to 50 per cent recovery rate, plus another 20 to 30 percent "showing considerable improvement," as described in the chapter entitled "Treatment of Alcoholism." This could be construed to mean that 60–80 percent at least "show considerable improvement," whatever that term means. We have not been so fortunate, and one wonders for how long the salubrious state of considerable improvement endures.

The book will be read with pleasure and profit by all interested in a challenge which, despite its hoary old age, has yet to be met.

J. A. Mendelson, M.D.

RH-HR SUS TIPOS Y APLICACIONES, por el Alexander S. Wiener, M.D., F.A.C.P., F.C.A.P. Traduccion al espanol por Darwin Molins, B.S., M.D. Revisada por el Dr. Federico Marin. La Prensa Medica Medica Mexicana, 120 pages, $3.50.

This book, translated from English into Spanish, is an excellent up-to-date compendium of the elementary as well as the more advanced complex concepts involving Rh-Hr factors and their applications not only to clinical medicine but also to its medicolegal aspects and to anthropology.

In the first three chapters simple clear-cut definitions are so arranged as to make the material extremely valuable for beginners as well as the experts who want to use the international terminology especially when treating with the complex problem of serology and genetics with which the subject is so closely associated. Serologic tests of fundamental and practical importance are thereafter described.

The practical aspects of Rh-Hr factors are dealt with in chapter four. Presently two methods are used for the interchange of blood in erythroblastotic babies, e.g., the umbilical catheter described by Diamond and the radial artery-saphenous vein method used by Wiener and Wexler. The advantages and disadvantages of both are clearly exposed.

Anthropologic and medicolegal aspects of the subject are discussed including valuable paternity-exclusion tables using Rh-Hr tests. In the appendix, an attempt is made towards a scientific and rational solution of the presently so much discussed problem of nomenclature involving the Rh-Hr factors. A valuable amount of evidence is presented in favor of the elimination of such letters as C, D, E. In Table 23, the nomenclature of Fisher-Race is compared with that used by Wiener, and the subsequent paragraphs give the author's views in favor of his classification.

In general, it may be said that this book is a valuable summary involving all the aspects of Rh-Hr factors written in simple easily understandable language covering the whole field and starting from the definition of antigen and antibodies, discussing its practical applications, and finally ending with the complex problem of nomenclature which the author tries to solve with scientific reasoning.

F. Santos